USN 52R / USN 52L

Technical Reference and Operating Manual

Ident No. 28 642

Introduction 1

1.1 Safety information

USN 52R and USN 52L have been designed and tested according to DIN EN 61 010 Part 1, March 1994, Safety requirements for electrical measuring, control and lab equipment, and was technically in perfectly safe and faultless condition when leaving the manufacturing works.

In order to maintain this condition and to ensure a safe operation, you should urgently read the following safety information before putting the instrument into operation.

⚠ **Attention:**

USN 52R and USN 52L are instruments for materials testing. Any use for medical applications or other purposes is not allowed!

The instruments may only be used in industrial environments!

Storage batteries

USN 52R/USN 52L can be operated with storage batteries. Please only use the power supply/battery charger unit UN 655 for storage battery charge.

Defects/errors and exceptional stresses

If you have reason to believe that a safe operation of your instrument is no longer possible, you have to disconnect the instrument and secure it against unintentional reconnection. Remove the batteries if necessary.

- A safe operation is e.g. no longer possible
- if the instrument shows visible damages,
- if the instrument no longer operates perfectly,
- after prolonged storage under adverse conditions (e.g. exceptional temperatures and/or especially high air humidity, or corrosive environmental conditions),
- after being subjected to heavy stresses during transportation.

Software

Based on the present state of the art software can never be completely error-free.

That is why software-controlled instruments should be checked before use to see if the necessary functions operate perfectly in the provided combination.

Therefore, please check the functions of the instrument according to the information given in Chapter 5.

Should you have any questions with regard to the application of your USN 52R/USN 52L, please contact your local “Krautkrämer” or “Krautkramer-Branson” agent.

1.2 Important notes

Please read the following notes before using your USN 52R/USN 52L. It is important that you understand and observe this information to avoid making any mistakes in operating the instrument. These could lead to false test results which can finally result in injury to persons or damage to property.

Preconditions for testing with ultrasonic flaw detectors

This Operating Manual contains all the necessary information on how to operate the USN 52R/USN 52L. There are, however, a number of factors which affect the test results obtained. In the following, please find a detailed description of the three most important conditions for reliable testing with ultrasonic flaw detection equipment:

- a properly trained operator,
- knowledge of the specialized test requirements and limits of testing
- selection of the appropriate test equipment.

Operator training

The operator of an ultrasonic flaw detector must be adequately trained in the field of ultrasonic test methods. This includes, among other things, sufficient knowledge of:

– sound propagation theory,

– the effects of the velocity of sound in the material,

– what happens to the sound wave at the interface between two different materials under test,

– the propagation of the sound beam,

– the effect of the sound attenuation in the object under test,

– the effect of the surface condition of the object under test.

Lack of knowledge here can lead to false test results with unforeseeable consequences.
Information concerning existing possibilities for the qualification of ultrasonic operators as well as the question of achieving these qualifications can be obtained from the corresponding NDT societies in your country (DGZfP in Germany, ASNT in the USA etc.), or also from Krautkramer-Branson.

Technical test requirements

Every ultrasonic test is subject to specific technical test requirements. The most important of these are:

- definition of the scope of the test;
- selection of the appropriate technical test method;
- taking into account the properties of the material;
- laying down the test limits for “recording and evaluation purposes“.

It is the task of those with overall responsibility for testing to ensure that the test operator is fully informed about these requirements. The best basis for such information is experience with identical test objects. It is also essential that the relevant test specifications be clearly and completely understood by the test operator.

Krautkrämer GmbH & Co regularly hold specialized training courses for qualified persons in the field of ultrasonic testing.

Scheduled dates of such courses will be given on request.

Limits of testing

Ultrasonic tests can only provide information about those parts of the test object which the sound beam from the probe used has actually passed through.

Extreme caution is advised in making any conclusions from the tested areas of the test object as to the condition of those parts of the test object which have not actually been tested.

Such conclusions are usually only possible where a large amount of previous data is available and proven methods of statistical evaluation are used.

Boundary surfaces within the test object can completely reflect the sound beam so that flaws or reflection points lying deeper remain undetected. Care must therefore be taken to ensure that the sound beam does in fact penetrate all those parts of the test object which are to be tested.

Wall thickness measurements with ultrasonics

All wall thickness measurements with ultrasonics are based on a time-of-flight measurement. Accurate measurement results require a constant sound velocity within the material. In test objects of steel, even with varying alloying constituents, this condition is usually fulfilled: the variation of the sound velocity within the material is so slight that it is only of importance for high-precision measurements. In other materials, however, e.g. nonferrous metals and plastics, the sound velocity can vary substantially within the material and cause inaccurate measurement results.

Effect of the material of the test object

If the test object is not of a single, homogeneous material, then the sound may propagate at different velocities in different parts of the object. In this case, the test range adjustment should be chosen for the average of the different velocities in the different parts of the object. This is done by using a calibration block in which the velocity of sound is the same as the average within the test object.

If substantial variations in the velocity of sound within the objects are anticipated, then the instrument should be readjusted at frequent short intervals to the actual sound velocity values present. If this is not done, false results may be obtained for the wall thickness.

Effect of temperature variations

The velocity of sound within the test object also varies as a function of the temperature of the material. This can cause appreciable errors if the instrument has been calibrated on a cold calibration block and is then used on a warm or hot test object. Such errors can be avoided either by warming the calibration block to the same temperature before calibrating, or by using a correction factor obtained from tables.

Measurement of remaining wall thickness

The measurement of the remaining wall thickness on plant components such as pipes, tanks and reaction vessels of all types which have been corroded or eroded from the inside requires a suitable test instrument and special care in handling the probe.

The test operator must be told the nominal wall thicknesses and the likely amount of the loss due to erosion or corrosion.

Assessing flaws using ultrasonics

In present-day test practice there are basically two methods of assessing flaws.

If the diameter of the sound beam is smaller than the extent of the flaw, then the beam can be used to scan the boundaries of the flaw and thus determine its area.

If, however, the diameter of the sound beam is greater than the size of the flaw, the maximum echo response from the flaw must be compared with the maximum echo response from an artificial flaw at the same depth provided for comparison purposes.

Flaw boundary scanning method

The smaller the diameter of the sound beam from the probe, the more accurately the determined flaw area corresponds to the actual flaw area when scanning the flaw boundaries with the sound beam from a probe.

If, however, the sound beam is relatively broad, the determined flaw area can substantially differ from the actual flaw area. Care should therefore be taken to select a probe which will give a sufficiently narrow beam at the position of the flaw.

Echo display comparison method

The echo from a small natural flaw is usually smaller than the echo from an artificial comparison flaw (e.g. circular disc reflector) of the same size. This is due, for instance, to the roughness of the surface of a natural flaw, or to the fact that the beam does not impinge on it at right angles.

If this fact is not taken into account when assessing natural flaws, there is a danger of underestimating their magnitude.

In the case of very jagged or fissured flaws (e.g. shrink holes in castings) it may be that so much scattering of the sound occurs at the surface of the flaw that no flaw echo is produced. In such cases, a different assessment method should be chosen, e.g. backwall echo attenuation method.

When testing large components, the distance sensitiveness of the flaw echoes plays an important role. Care should be taken here to choose artificial comparison flaws whose distance sensitivity laws come as close as possible to those of the natural flaws being assessed.

Ultrasound is subject to attenuation as it passes through any material. This attenuation is very small in, for instance, fine grained steel, and also in many small components made of other materials.

If, however, the sound travels a large distance into the medium, then even at low attenuation coefficients a large cumulative attenuation can result. There is then a danger that echoes from natural flaws appear too small.

For this reason, the effects of sound attenuation on the evaluation results must always be estimated and, if necessary, taken into account.

If the test object has a rough surface, part of the incident sound energy will be scattered at its surface and is lost to the test instrument. The larger this initial scattering, the smaller the echoes appear, and the more incorrect also the results of the evaluation.

It is therefore important to make an allowance for the surface roughness of the test object and apply a correction to the observed height of the echoes (transfer correction).

1.3 USN 52R/USN 52L

USN 52R/USN 52L are lightweight, compact ultrasonic flaw detectors which is especially well suited for

- locating and evaluating material flaws,
- measuring wall thicknesses.
- documenting all test results and readings.

USN 52R:

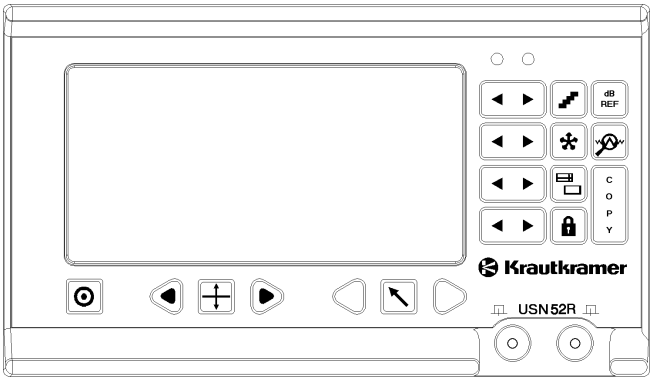
- high-resolution EL display, 146 mm x 67 mm (5.75“ x 2.65“), 552 x 256 pixels

USN 52L:

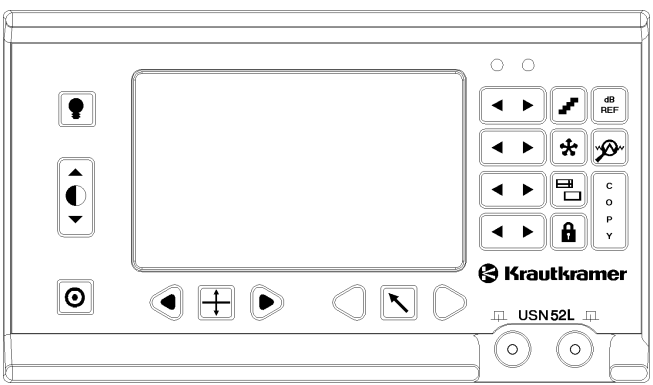
- transflective LCD screen, 114 mm x 75 mm (4.5“ x 3.0“), 480 x 320 pixels

Special features of the two versions:

- lightness in weight (2.7 kg including batteries) and small in size,
- an easy-to-clean keypad,



USN 52R



USN 52L

- 60 Hz A-scan refresh rate,
- mains power or battery operation (max. 5 hours of operation),
- on-board Data Logger for storage of up to 2,500 thickness readings in a maximum of 99 freely configurable files,
- RS232 interface for data transfer, A-scan displays and reports, or for remote control of the USN 52 R,
- storage of 140 (USN 52R) / 100 (USN 52L) control data sets enabling quick calibration and reproducibility of the test,
- alphanumeric entry of data set names and display of a directory of all data sets,
- frequency ranges from 0.25 - 11 MHz wide band
- echo representation: RF signal, full-wave, positive and negative half-wave,
- optimized probe matching by means of 4 adjustable damping values between 50 and 1000 ohms,
- automatic calibration of the sound velocity and probe delay according to data from 2 calibration echoes (with plausibility check),
- 2-stage adjustment of pulse repetition rate in order to avoid phantom echoes,
- indication of amplitude and sound path for flaw testing and thickness measurement,
- DAC for convenient display evaluation according to the reference block method (e.g. ASME code, etc.),
- analog outputs for external control purposes: proportional voltage for amplitude and sound path of the echo in the monitor gate,
- A-scan storage, peak freeze and zoom function,
- preview of all stored A-Scans,
- locking function to avoid unintentional alteration of set values,
- magnified display of measured values for easy reading even from longer distances,
- rapid switching between programmable sound velocities, e.g. for longitudinal and transverse waves in steel.

1.4 Remarks on this manual

☞ **Note**:

This manual applies to the two USN 52 versions USN 52R and USN 52L. The examples shown refer to the USN 52R; however, since function groups and functions of the two instruments are basically the same, the examples also apply to the USN 52L. Only the display size and type are different. For more details on the differences between the two versions, please refer to pages 1-8 and 4-2 to 4-3.

Before starting for the first time

Before operating your USN 52 R for the first time, read Chapters 1 and 3 in this manual. There you will find a description of the necessary preparations for starting. In addition to this, you will be informed about the most important adjustment possibilities available on the front panel of the instrument.

By doing this, you will avoid interferences or failures and you will be in a position to use the instruments's function range to the full.

Getting to know the adjustment functions

Chapters 4 and 5 describe the most important adjustment functions using the corresponding menus. In Chapter 10 you will find a list and a brief description of all functions together with adjustment criteria.

Service

Chapter 10 also contains a list of After-Sales Service Centers which can be contacted in case of defects.

Specifications and basic settings

The USN 52 R specifications are contained in Chapter 9.

There is a basic setting for each adjustment function, this can be seen in the function tables in Chapter 8: default values are shown in bold-face type.

Layout of this manual

In order to simplify use of this manual, the operating steps are always presented in the same way. This enables you to find information quickly.

Descriptions of functions

Chapter 5 shows the functions that you require for various operating procedures in the same way as they are displayed by the USN 52 R, e.g.:

a-START

Operating steps

The operating steps are presented in the same way as in the following example:

With ◀ ▶ mark the second function group in the right-hand table.

With ◀ ▶ set the function **PARITY** to **ON**.

Keys

– ◁ ▷ / ◀ ▶ / ◀ ▶ mean:
Press the right or left key.

– ◁ / ◀ / ◀ mean:
Only press the left key.

– ▷ / ▶ / ▶ mean:
Only press the right key.

Note:

Under **Note** you will find, for example, references to other chapters or special recommendations.

Attention:

The **Attention** symbol warns you about wrong operation when the correctness of the results is endangered.

Standard package and accessories 2

Standard package and accessories

This chapter gives information about all parts and options supplied for the USN 52R/USN 52L.

Among others, it describes:

- Accessories in the Standard Package
- Accessories required for operation of the instrument
- Recommended accessories
- Outside products configured for operation with the USN 52R/USN 52L which have been successfully proven and were tested in connection with the instruments at our company.

2.1 Standard package

Product type	Description	Order no.
USN 52R	Portable ultrasonic flaw detector with high-resolution EL display,	
	with probe connector LEMO 00	34 900
	with probe connector BNC	34 901
USN 52R DGS	Portable ultrasonic flaw detector with high-resolution EL display, including DGS function	
	with probe connector LEMO 00	34 911
	with probe connector BNC	35 022
USN 52L	Portable ultrasonic flaw detector with transflective LCD screen	
	with probe connector LEMO 00	35 062
USN 52L DGS	Portable ultrasonic flaw detector with transflective LCD screen, including DGS function	35 063
	including:	
	Operating manual (English) or	28 641
	Operating manual (German)	28 642

2.2 Required accessories

Product type	Description	Order no.
UN 655	Power supply/battery charger unit	34 941
NCA 2-6	Set of six NiCd batteries	25 812

2.3 Recommended accessories

UN 777	Case with light shield and strap	34 094
UN 762	Light shield	34 093
UN 685	Charging frame for NiCd batteries	33 763
UNRCH	External charging adapter cable (connects UN 655 with UN 685)	18 840
UNCO	Remote copy switch	05 301
TGDL/PC	Cable for transfer of data to the PC. LEMO 00 7-pin to DB 25S. Incl. adaptor DB 25P to DB 9S for AT	13 647

Product type	Description	Order no.
GCH1	Adaptor DB 25P (gender changer) to connect the USN 52/PC cable to a printer with serial interface (EPSON)	13 648
GCH3	Adapter (gender changer) to connect the USN 52/PC cable to a Seiko printer (DPU 414)	34 797
UNAN	Connecting cable for analog output (one end open)	17 337
UN 100 W	UltraDOC for USN 50/52	33 827

2.4 Recommended outside products

	Printer EPSON LX-300	17 995
	Printer Seiko DPU 414	17 993

Setting into operation 3

It is imperative that you observe the instructions given in this chapter before setting the instrument into operation.

Here you will be informed about the necessary preparations before startig the instrument for the first time in order to avoid any damages or wrong measurement results.

3.1 Positioning the USN 52R/ USN 52L

Refer to Chapter 9 concerning the permitted ambient conditions, such as temperature and humidity. Position the instrument on a smooth surface so that the display can be easily read.

If the instrument is taken from a cold area into a warm area, you should wait until it has adjusted to the temperature before switching on (avoids condensation).

3.2 Power supply

There must be sufficient power in order to guarantee operation.

The instrument can be operated with batteries or on mains power via a special instrument charger.

Battery operation

For battery operation, you will either require 6 NiCd or alkaline batteries (D-cells). The current battery voltage is indicated on the display by a symbol:

☞ Note:

The batteries should be exchanged as soon as possible when the charge indication is at about 25%. The instrument automatically switches off when reliable operation can no longer be ensured. We recommend that a spare set of fully charged batteries be available when using the instrument for longer periods outside.

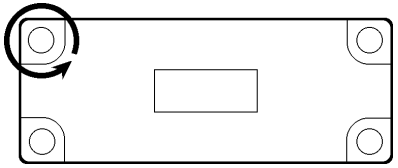
When the batteries are exchanged, all settings will remain stored and are instantly available when switching on again.

☞ Note:

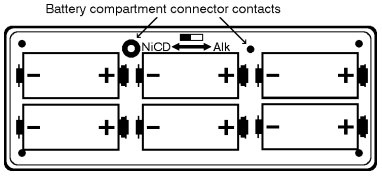
Used or defective batteries are special refuse and shall be disposed of according to legal regulations.

Inserting the batteries

To insert new batteries, you must first loosen the four screws at the bottom of the instrument (see following figure) and then remove the battery compartment lid.



Each battery in the battery pack is secured with a separate holder.



⚠ Attention:

When inserting the batteries, make sure that the polarities are correct and that the switch in the battery compartment is set to the type of battery being used!

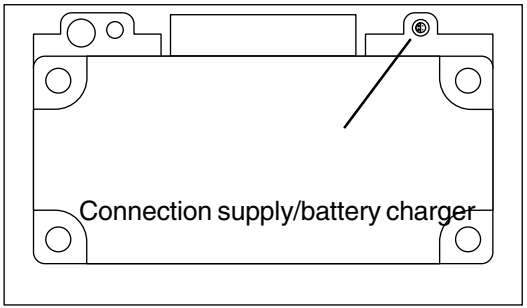
Nickel Cadmium (NiCd):	left
Alkaline (Alk):	right

This ensures that only rechargeable batteries are charged.

Using the battery charger

The power supply/charger unit for USN 52R/USN 52L automatically adjusts itself fo the existing supply voltage in the range from 80 to 250 V.

The connection for the combined power supply/charger unit is at the rear of the instrument (see following figure).



When using the power supply/charger unit you are able to simultaneously charge NiCd cells in the USN 52 R and operate the instrument. The power supply/charger unit requires 4 to 7 hours in order to fully charge the NiCd cells.

The green LED indicates that the power supply/charger unit is connected to mains.
The yellow LED of the power supply/charger unit indicates the operational status:

LED	Status
LED off	- instrument is switched off - no NiCd batteries in the insturment - instrument is set to AlMn
LED on	- instrument is switched on - NiCd batteries are being charged
LED flashes	- instrument is switched off - NiCd batteries are fully charged (trickle charge)

Attention:

If you have inserted AlMn cells and the switch is set to NiCd, the internal charge of the cells will be isolated. In this case, the AlMn cells will become quickly hot and the pressure in the cells will cause a leakage of electrolyte after a short period of time. This strongly caustic fluid can damage the instrument!

Only use the batteries that we recommend. There is a danger of explosion if the charger and the batteries are incorrectly used.

3.3 Probe connection

The probe connections are on the lower right of the front panel.

Connect straight-beam probes to the red socket (Receive - right). With T/R probes, connect the pulser cable to the green socket (left) and the receiver cable to the red socket (right).

– Set the pulser power as follows:

– Switch the USN 52 R on with ⊙.

– Select the function group **RCVR** by pressing ▷.

– Using ◁ or ▷, set the damping resistor in function **DAMPING** There are 4 settings available: 50, 75, 150 and 1000 ohms.

3.4 Starting the USN 52 R

Switching on

This is the normal way of switching on the USN 52 R.

– Press the switch-on key ⊙ in the operator's control panel.

After a short time, the start display appears with information about the applied software version and about the instrument configuration.

The settings for all function values and default settings are the same as before switching off.

Reset

If you are not able to operate the functions after a warm start, you must carry out a cold start:

– Press ⋮ and ◎ together.

– Keep ⋮ pressed until the A-scan appears.

Attention:

The instrument has now the factory-preset default setting. The dialog language is English.

Refer to Chapter 4 for changing the default settings according to your own requirements.

3.5 Screen saver

USN 52R/USN 52L are equipped with a screen saver in order to extend the life of the display screen and the operating time of the batteries. If your instrument is on, and you have not pressed a key, and no positive gate violation has occurred for 30 minutes the text/graphics portion of the display will be erased and only a live A-scan trace will be displayed. If a frozen image is being displayed when the unit goes into screen saver mode, the frozen image will be lost. To exit the screen saver mode, you must press a key or have a positive gate violation. The keypress to exit screen saver mode will not change any instrument settings. When screen saver mode is exited, the screen will return to the display which was present before.

Basics of operation 4

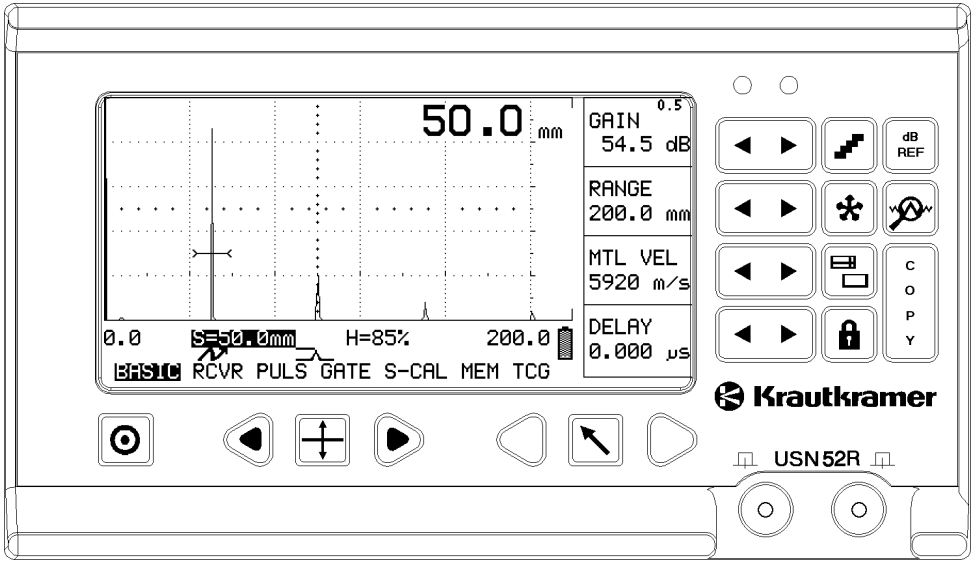
4.1 USN 52R and USN 52L

The present operating manual applies to both instrument versions. Operating concept, operating levels, function groups and functions of the two instruments are basically the same.

The only difference is the type and size of the display screen or its setting.

USN 52R: The screen brightness of the EL display is set in the function **INTENSITY** (Please refer to page 5-45).

USN 52L: The LCD screen is set using special keys (please refer to page 4-3).

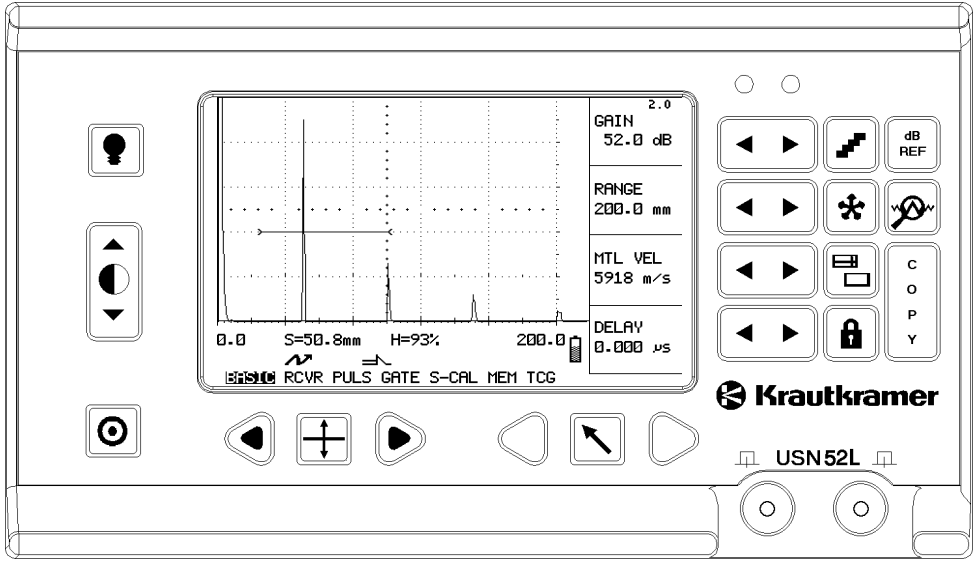


USN 52R

The USN 52L is provided with the following special keys for the LCD screen:

switches the display backlight directly on and off.

varies the brightness / the contrast of the LCD screen.



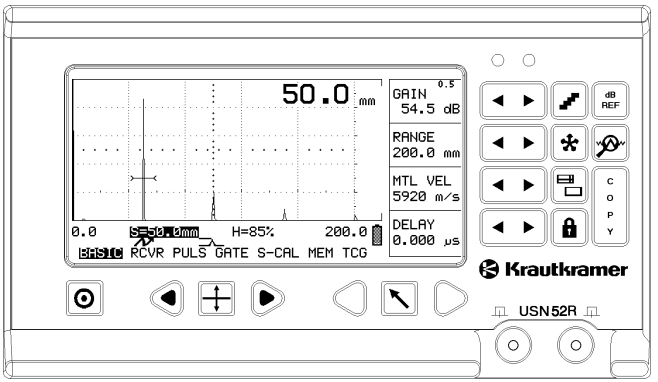
USN 52L

4.2 Display

A-scan display

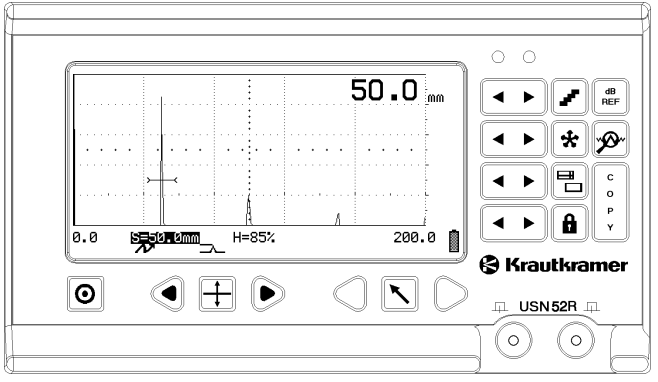
The digital display shows the A-scan either

- in the normal mode
  with measured-value overlay - the value highlighted in the measurement line is overlaid on the display.



- in the enlarged mode
  display mode with overlaid measured value.

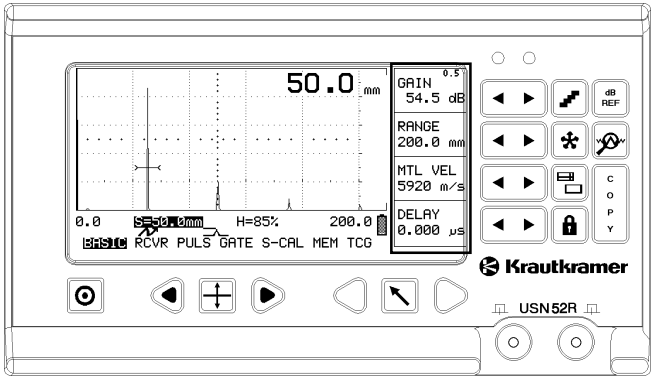
– Press ⧉ for switching over.



Functions on the display

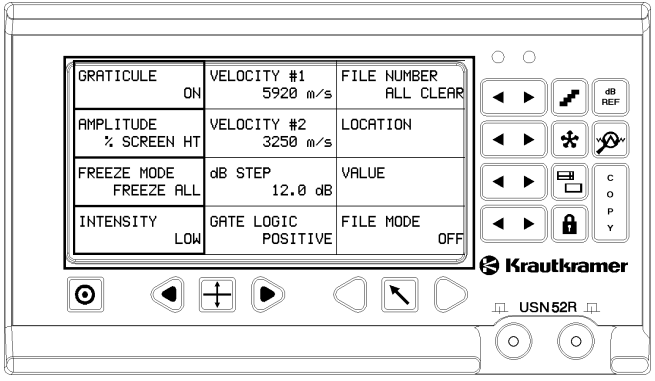
Selected function groups are shown on the display:

- In the first operating level one selected function group is displayed in addition to the A-scan.



- In the second operating level there are 3 groups compiled into one function table (refer to fold-out page).

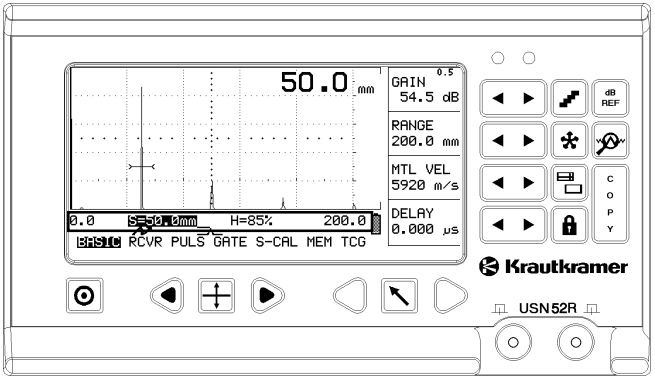
– Press ⊞ for switching between the two operating levels.



Indications beneath the A-scan

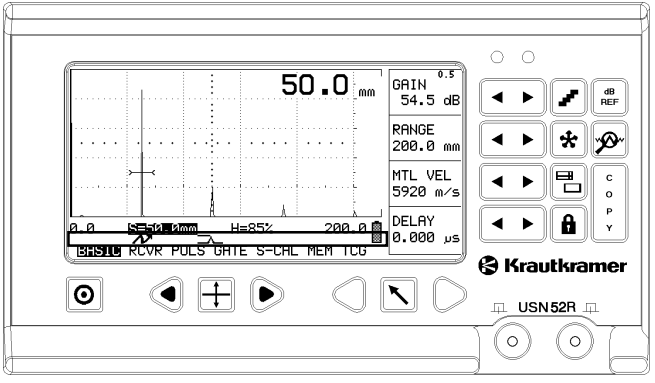
Measurement line

The current measurement results are displayed here. The contents of this line depend on the settings of the functions **MEASURE, TOF, AMPLITUDE, FILE MODE, ANGLE and X-VALUE.**



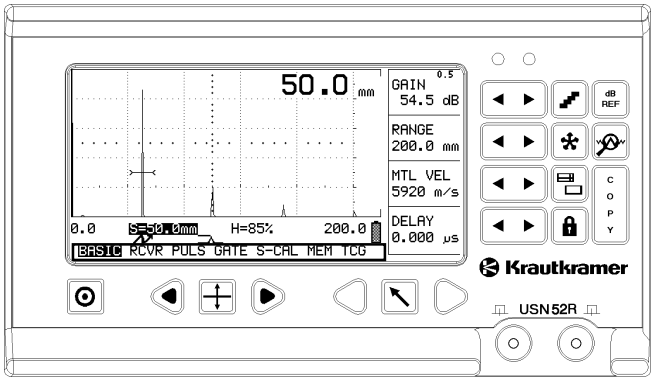
Status line

Symbols appear here which indicate certain settings, e.g. battery charge status (please refer to fold-out page).



Menu line

The function groups in the first operating level are displayed here. The selected group is inverted.

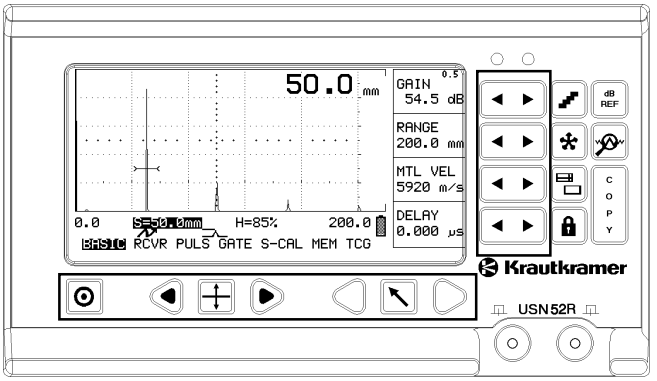


4.2 Keypad

Function keys

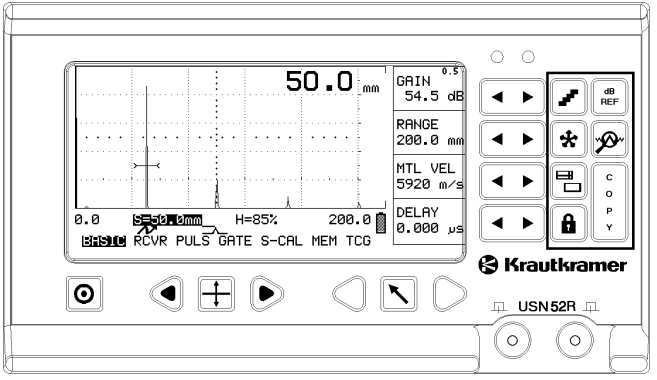
– Below: for function group selection and for switching over between operating levels.

– To the right: for changing instrument settings and values.



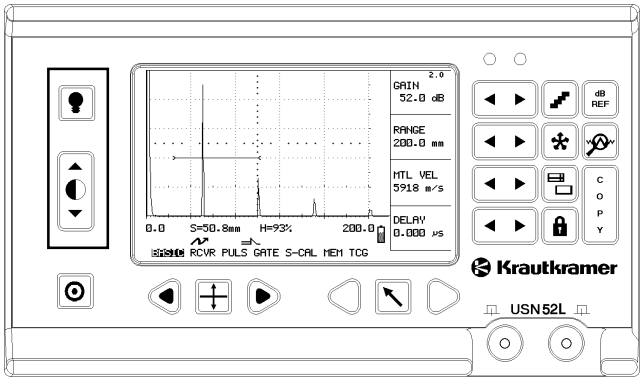
Special keys

– for special instrument functions



Special keys of the USN 52L for setting the display

For switching the backlight on and off, and for setting the contrast/brightness.



4.3 Operational concept

The functions are divided into two operating levels.

– In the first operating level you will find the most frequently used functions divided into seven function groups. You can toggle between the function groups as you like.

– The second operating level contains seven groups of functions which do not influence the A-scan. That is why the A-scan is removed here and the whole screen used for display of the function tables between which you are able to switch back and forth as you like.

Changing the operating levels

Press ⊞ in order to toggle between the first and the second operating level.

Selection of function groups and functions

– With ◁ or ▷ you can select a function group.

– With ◀ or ▶ you can change between the function tables in the second operating level.

Setting the function

To the right of each function you will find a pair of keys ◂ ▸. With ◂ you will decrease the displayed value and with ▸ you will increase it.

Accelerated adjustment

You are able to accelerate the adjustment of all functions having a certain adjustment range in order to quickly bridge large differences between the values.

Press ◂ or ▸ and keep it pressed. The accelerated adjustment is completed as soon as the key is released.

Example: Adjustment of sound velocity

– Select the function group **BASIC**.

– In **MTL VEL** press ◂ or ▸ in order to change the sound velocity.

Selection of measured value for enlarged display

Using ◀ ▶ in the measurement line select the value which is to be enlarged on the display.

With ◀ ▶ you also can toggle between graticule scaling in scale divisions (Div.) and display of the RANGE/ DELAY in the measurement line. For this, either the function **GATE LOGIC** or **MEASURE** must be set to OFF (both functions: lower operating level).

4.4 Function keys

With the function keys you select functions and change the indicated settings:

Key	Function
⊙	Switches the USN 52 R on and off
↖	Returns to the first operating level and to the **BASIC** function group
◀ ▶	Selects measured values or function tables
◁ ▷	Selects function group.
◂ ▸	Changes active setting
⊞	Change of operating level

4.5 Keys for special functions

Important functions and special functions can be selected via special keys on the right-hand side of the operating field:

Key	Function
	dB-Step – Changes step size for the gain setting
	dB-REF – Stores reference echo
	Display freeze – Freezes display
	Copy – Transmits data to the RS232 interface
	Zoom – Expands the echo display over the whole screen
	Magnify – Expands the gate over the whole display width
	Lock on/off – Locks function values

Only USN 52L

The USN 52L is provided with two additional special keys on the left-hand side of the display. They are used for setting the LCD screen.

Key	Function
	Backlight - Switches the display backlight on and off.
	Contrast - varies the brightness / contrast of the LCD screen.

4.6 Important basic settings

Set language

In the **LANGUAGE** function in the second operating level you can select the language in which the names of the functions are to be displayed.

The following languages are available:

- German
- English
- Italian
- French
- Spanish
- Portuguese
- Swedish
- Danish
- Norwegian
- Finnish
- Dutch
- Russian

Operation:

– Change to the second level with ⊞.

– Select the left-hand function table with ◀ ▶.

– Highlight the left function group with ▷.

– Set the required language in the **LANGUAGE** function with ◁ or ▷.

– You will return to the first operating level with ⊞ or ↖.

Setting the measurement units

In the function **MEAS. UNITS** in the second operating level you can determine the measurement units in which you wish to operate the instrument (mm or inches).

Operation:

– Change to the second operating level with ⊞.

– Select the left-hand function table with ◀ ▶.

– Highlight the left function group with ▷.

– Using ◁ or ▷ in **MEAS. UNITS** set the required units.

– You will return to the first operating level with ⊞ or ↖.

Operation 5

5.1 Function overview (first operating level)

In the first operating level you will find all functions required for basic adjustment of the USN 52R/USN 52L. They are compiled into function groups allocated to certain operation tasks.

In order to change between the function groups, press ◁ or ▷.

Function group	Contents
BASIC	Here you can enter the basic settings for the measurement
RCVR	Here you can set the functions of the receiver.
PULS	In this group you will find the functions for DUAL/SINGLE changeover
GATE	Contains all functions for adjusting the positions of both gates.
S-CAL	Contains all functions for the calibration of the digital sound path measurement.
MEM	Contains functions for storing your data into the memory.
TCG	You can use these functions to operate the DAC/TCG.

5.2 Adjustment of the USN 52R/ USN 52L

GAIN Gain adjustment

With this function the echoes of the reflectors to be detected are amplified so that they appear on the display at the required height.

In order that you are able to change the gain at any time, you will find this function in all function groups of the first operating level.

Operation:

– Change the setting of **GAIN** with ◄ ►.

⤢ -Setting the dB STEP

You set the gain with a certain step size which you can select with ⤢. There are five steps available:

- 6.5 to 24 dB
  (variable via **dB STEP** in the second operating level, refer to Chapter 5.6)
- 6.0 dB
- 2.0 dB
- 1.0 dB
- 0.5 dB
- 0.1 dB

Operation:

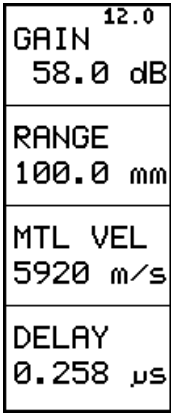
- Press ⤢ in order to change between the five steps.

The set step is displayed as a value in the **GAIN** function.

Selection of basic data

In this function you set the different values which serve as a measurement basis and for the display indication.

– With ◁▷ go to the **BASIC** function group.



RANGE Calibration range

In this function you set the display range for the A-Scan. In doing this, you can select between two settings:

- **coarse:** in steps
  - 5 mm
  - 10 mm
  - 25 mm
  - 50 mm
  - 100 mm
  - 125 mm
  - 200 mm
  - 250 mm
  - 500 mm
  - 1000 mm
  - 5000 mm
- **fine:** continuous from 5.0 mm bis 5000 mm. The function name appears in small letters (“Range”).

Operation:

– Press ◁ or ▷ in order to change between the steps or to continuously select the required value.

– Coarse/Fine change-over: Simultaneously press ◁ and ▷ in **RANGE**.

Note:

The setting is limited by the set sound velocity.

The measurement units for all settings – mm or inches – can be selected in the second operating level.

MTL VEL Setting the sound velocity

In this function you enter the test object's sound velocity as a reference value. You have two possibilities:

Coarse: switch between the two preset values, e.g. 3353 m/s or 5918 m/s.

Fine: set a value between 1000 m/s and 9999 m/s. The name of the function appears in small letters (**mtl vel**)

Note:

You can select the two values for the coarse setting in the second operating level.

Operation:

– Press ◄ ► to change the displayed value. The set value is displayed in the **MTL VEL** function.

– Coarse/Fine change-over: Simultaneously press ◄ and ► in **MTL VEL**.

DELAY Setting the delay

In this function the timing of the sweep start is adjusted.

Operation:

– Set a value between -20 µs and 999 µs (range dependent) in steps of 0.008 µs with ◄ ►.

– Reset delay to 0.000 µs: simultaneously press ◄ and ► in **DELAY**.

Note:

In order to take the probe delay into account, you must calibrate the probe zero point with **ZERO** in the function group **S-CAL**.

Setting the receiver

All functions for adjustment of the receiver can be found in the function group **RCVR.**

– With ◁▷ go to the function group **RCVR.**

FREQ. Frequency

With this function you can set the operating frequency.

You can choose between four settings:

- 0.4 - 10 MHz = broadband amplifier
- 2 - 8 MHz = 4MHz according to DIN 25 450
- 3 - 10 MHz = high frequency range
- 0.3 - 4 MHz = low frequency range

Operation:

– Select the required setting in **FREQ.** using ◂▸.

DAMPING Electrical damping of the probe

You can use the function **DAMPING** to connect various resistors in parallel to the probe in order to achieve an optimum matching of the probe's electrical impedance to the instrument.

– Select a low value with broadband probes, or if you wish to improve the near resolution.

– Select a high value if you are using narrow-band probes, or if you need a high sound intensity.

Operation:

Set the required value in **DAMPING** using ◂ ▸.

RECTIF. Setting the rectification mode

In the **RECTIF.** function you select the rectification mode of the echo pulses according to the application. You have the following possibilities:

- **FULL** (full-wave): All half-waves above the base line are displayed
- **RF** (radio-frequency display): All signals are displayed in their original form.

☞ Note:

The RF display mode is only adjustable if the function **INTENSITY** (display brightness) is set to LOW and the range does not exceed 196 mm (with 5920 mm).

- **NEG HALF** (negative half-wave): Only negative half-waves are displayed.
- **POS HALF** (positive half-wave): Only positive half-waves are displayed.

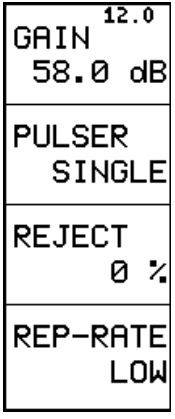
Operation:

– Select the required setting in **RECTIF.** with ◂ ▸.

Setting the pulser

In the function group **PULS** you can change the operating mode and the pulse repetition rate of the pulser as well as operate the reject function.

– Use ◁▷ to go to the function group **PULS**.



PULSER Changeover of initial pulse

You can use this function to change between the single-element or dual (T/R) mode for the instrument operation:

- **SINGLE:** single-element operation mode; the probe connector sockets are connected in parallel.
- **DUAL**: dual (T/R) operation mode; the initial pulse is available at the green socket - the red socket is connected to the amplifier input.
  Select this setting if you are using a dual (T/R) probe or the through-transmission mode.

Operation:

– Select the required setting in **PULSER** using ◂▸.

☞ **Note:**

The corresponding symbol will be displayed in the status line:


Single


Dual

REJECT Suppression of spurious echoes

With the **REJECT** function you are able to suppress unwanted signals, e.g. material noise.

The setting, given in percent, indicates the height that echoes have to reach in order to be displayed in the first place.

Operation:

In **REJECT** set the required percentage value with ◄ ►.

⚠ Attention:

Be careful with this function because flaw echoes can also be suppressed.

REP-RATE Repetition rate

The number of the ultrasonic signals emitted per second is varied using this function. This enables selective suppression of spurious or interference echoes and especially phantom echoes which may occur when testing larger test objects. The function enables two settings:

- **HIGH**: Maximum pulse repetition rate (113 to 905 Hz, depending on the range setting); default setting.
- **LOW**: Reduced pulse repetition rate (56 to 452 Hz, depending on the range setting); for testing larger test objects or in case any statistical noise signals occur.

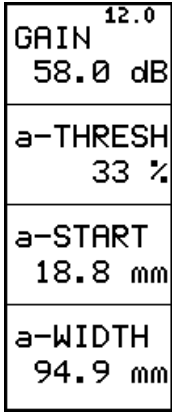
Operation:

In **REP-RATE** set the required percentage value with ◄ ►.

Gate adjustment

All functions for adjustment of Gates a and b are contained in the function group **GATE.**

– With ◁▷ go to function group **GATE.**



The gates have two tasks:

- They monitor the area of the test object in which a flaw is expected. When an echo exceeds or falls below the gate, a warning signal can be activated.
- They select the echoes for the digital time-of-flight or amplitude measurement.

USN 52R/USN 52L make the two gates a and b available. Gate b is only required for the measurement or calibration of multi-echo sequences and enables the measurement of the distance between two echoes. The flaw Gate b is dependent of Gate a and is correspondingly adjusted:

- **b-START:** at 10% to 90% of a-WIDTH (after a-START)
- **b-THRESH:** 10% to 90% screen height

⚠ **Attention:**

When both gates are superimposed on each other, the wrong values can be indicated with a wrongly selected Gate b.

Both gates evaluate only within the visible area of the display. If there are gates or parts of gates outside this area, an evaluation will not be made.

Operation:

The **MULTECHO** setting of the function **MEASURE** (lower operating level) is a prerequisite for operation.

- Simultaneously press ◄ and ► in **a-WIDTH** or **a-THRESH** in order to switch to the settings for Gate b.

a-THRESH Determination of threshold

With this function you determine the threshold for the selected gate. You can set a range from 10% to 90% screen height in 1% steps.

Operation:

– Set the required threshold value in **a-THRESH** with ◄ ►.

The selected gate is displayed as a line.

If there is a violation of the set threshold (signals exceeding or falling below it), an alarm is activated.

The exact gate position is defined by two further parameters:

- Gate start **(a-START)**
- Gate width **(a-WIDTH)**

a-START Start of the gate

In the function **a-START** you determine the start of Gate a within a range from 0 to 5000 mm (continuous).

a-WIDTH Width of the gate

In the function **a-WIDTH** you determine the width within a range from 1 to 5000 mm (continuous).

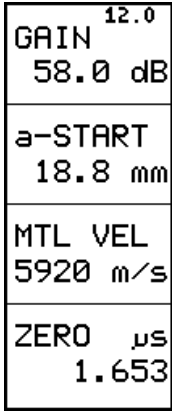
Operation:

– Set the gate position in **a-START** and **a-WIDTH** with the assigned ◄ ► keys.

Calibration functions

USN 52R/USN 52L are accurately calibrated using the functions of the function group **S-CAL**.

– With ◁ ▷ go the function group **S-CAL.**



Note:

In order to obtain the correct setting, you must have selected the display range, according to the test task, in the function group **BASIC** beforehand.

Note:

Read Chapter 5.3 first in order to exactly set the sound velocity and the probe delay.

Note:

Refer also to the **AUTO CAL** function in Chapter 5.3. The function group **S-CAL** correspondingly changes when this function is used.

a-START Gate start

The active value for the gate start, which you have entered into the function group **GATE**, is displayed in **a-START.** If necessary, you can make a subsequent change to this value here.

MTL VEL Sound velocity

In **MTL VEL** you set the value for the sound velocity in the material under test. You can change between preset fixed values or continuously adjust the value.

Operation:

– Set the sound velocity in **MTL VEL** with ◄►, e.g. 5920 m/s (longitudinal wave velocity in steel).

Note:

The default value for the sound velocity can be changed in the second operating level (functions **VELOCITY # 1** and **VELOCITY # 2**) if you frequently operate with other materials (refer to Chapter 5.6).

Adjustment of the freely selected value:

– Simultaneously press ◄► in **MTL VEL.**

– Change the setting with ◄►.

With free adjustment of the value, the function name appears in small letters **(mtl vel)**. In this way you are able to recognize which mode of adjustment you have selected.

Attention:

Always make sure that the sound velocity in **MTL VEL** is set correctly! The instrument calculates all interval and distance indications using the values which have been set here.

ZERO Probe delay

Each probe has a delay block (protective layer, delay wedge with angle-beam probes) between the element and the coupling surface. The initial pulse must be transmitted through this delay block before the sound can enter the test object. The **ZERO** function allows you to take into account the loss of time caused by the delay block in order to achieve the correct measurement of all sound paths in the test object.

Operation:

Set the value for the probe delay in **ZERO** using ◄►.

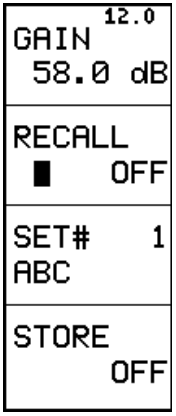
Note:

If the value for **ZERO** is not known, read Chapter 5.3 beforehand in order to determine this value.

Storing data

This group contains functions for storage and recall of your data.

– With ◁ ▷ go the function group **MEM.**



Note:

To be able to find everything better, you can store a name (max. 8 alphanumeric characters) with every data set. If the **MEMO** function is activated, you have additional possibilities of data set description (free formulation of texts or filling-in of predetermined header fields) to improve the documentation. Please read the sections **Data set names** and **MEMO mode** in chapter 5.10 on this.

RECALL Loading of a stored setting

With this function you can load the instrument settings (data set) which you have previously stored. If a data set contains a stored setting, this will be indicated by the symbol ■ in the **RECALL** function.

Attention:

The active settings will be overwritten, therefore store beforehand in order to save them.

Operation:

– With ◂▸ switch to **ON** so that the settings can be loaded. When the sequence is finished, the display automatically changes to **OFF.**

– Acknowledge system safety prompt with ↖.

SET# Selection of data set

You are able to select the required data set number with this function. If necessary, an allocated data set name will be displayed at the same time.

Additionally, you can give each data set a name with which it is stored. Refer to Chapter 5.10 *Entering and displaying data set names*.

Operation:

– Select a number between 1 and 140 (USN 52R) / 1 and 100 (USN 52L) with ◄►.

STORE Storing the instrument settings

With this function you store the active instrument settings and the active A-scan under the number indicated in **SET#.**

If the data set is already allocated (symbol ■) you cannot overwrite it. You must firstly clear the old data set.

Operation:

– Switch to **ON** with ◄► to store the setting. When the process is completed, the display automatically changes to **OFF.**

– Acknowledge system safety prompt with ↖.

– If required, enter the required additional information in the displayed **MEMO** menu (please see chapter 5.10).

Clearing the instrument setting

An instrument setting which is stored can be overwritten after you have disabled the write protection.

You can reallocate the data set.

Operation:

– Simultaneously press ◄ and ► in the **RECALL** function.

– Acknowledge system safety prompt with ↖.

Write protection is disabled. The symbol ■ is deleted. The data set can now be reallocated.

Clearing all data

You can clear all data sets (data logger and active instrument settings).

Operation:

– Switch off the instrument.

– Keep keys ↖ , ✱ and ◎ simultaneously for approximately 10 seconds.

All data sets are now cleared.

Displaying stored A-Scans (preview)

In the function group **MEM** you have the possibility to display all A-Scans belonging to the stored data sets without having to load them simultaneously. In this way, you obtain a quick overlook of your stored data.

Operation:

– Simultaneously press ◄ and ► in the function **SET#**.

The selected data set's A-Scan is displayed. At the same time, the function **GAIN** is changed in **DATA SET PREVIEW** as recognition of this preview function.

If additional information was stored for this data set by means of the **MEMO** function, the first 46 characters of this additional information are displayed in the menu bar (please refer to chapter 5.10).

– You can scroll through all stored data sets using ◄►. The corresponding A-Scans are displayed.

– If you require to load a displayed data set, set the **RECALL** function to **ON** using ◄► and acknowledge system safety prompt with ↖. The preview function will then be switched off.

– If you do not wish to load a data set: exit the preview function by pressing ◄ and ► simultaneously in **SET#**.

5.3 USN 52R/USN 52L calibration

Calibration of display range

Before you operate the instrument, you must calibrate it. Depending on the material and the dimensions of the test object, the sound velocity and the calibration range have to be set and the probe delay taken into consideration. In addition, the test sensitivity has to be adjusted according to the specified requirements.

⚠ Attention:

In order to reliably operate the instrument, adequate training in ultrasonics is required.

Calibration guarantees that

– the total thickness of the test object is displayed,

– the distance to the flaw or to the backwall of the test object can be determined using the horizontal position of the echo, or it can be digitally displayed,

– all flaws are displayed which must be detected according to test specifications,

– the size of the flaw can be determined by comparison with a known reflector.

☞ Note:

For all calibration procedures, use a calibration block which is made of the same material and has the same temperature as your test object.

The following examples show three main methods of ultrasonic testing:

- Testing with a straight-beam probe,
- Vertical testing with a dual (T/R) probe,
- Angle beaming with an angle-beam probe (transverse waves).

With all calibrations you must

– set the pulser and receiver according to the test task and

– decide whether you are going to use the FLANK or PEAK mode for your measurements (**MEASURE** function int the lower operating level) before calibrating.

Recommendation:

As long as the echoes to be evaluated indicate a distinct maximum amplitude, select the PEAK mode of measurement.

Basic adjustment:

Before calibrating the instrument, you must carry out the following basic adjustment:

Group	Function	Setting
BASIC	DELAY	0.000 ms
	RANGE	adjust

Calibration with a straight-beam probe

Known sound velocity, no delay block

– Set sound velocity **MTL VEL**

– Position Gate a over one of the echoes

– Adjust **ZERO** so that the correct “S=...”-value is indicated in the measurement line.

Example:

Carry out the calibration on a flat calibration block V1 (thickness: 25 mm) for a calibration range of 100 mm.

– Set **RANGE** to 100 mm

– Set known sound velocity **MTL VEL** (5920 m/s)

– Position the gate over the first calibration echo out of 25 mm

– Adjust **ZERO** so that “S=25.0" is displayed in the measurement line

The display range is now calibrated for the described task.

Sound velocity unknown, no delay block

– Set **MEASURE** to **MULTECHO**

– Set the gates so that the first echo is evaluated in Gate a and the second echo in Gate b.
Attention: Be careful of node errors when adjusting the threshold!

– Adjust the sound velocity **MTL VEL** until the displayed reading (sound path between the two backwall echoes) corresponds to the actual thickness of the test object. If necessary, you have to readjust the gate parameters.

– Set **MEASURE** to **0 TO 1st**

– Increase **ZERO** until the correct sound path value for the echo is displayed.

Example:

– Carry out calibration on a 25 mm thick test piece for a calibration range of 100 mm.

– Set **RANGE** to 100 mm

– Set **ZERO** to 0.000 s

– If possible, when in **MTL VEL**, set an approximate value for the sound velocity

– Set **MEASURE** to **MULTECHO**

– Adjust the gates so that the first echo is evaluated in Gate a and the second in Gate b.
Attention: Be careful of node errors when setting the threshold!

– Adjust the sound velocity **MTL VEL** until the displayed reading (sound path between the two backwall echoes) corresponds to the actual thickness of the test object. If necessary, you have to readjust the gate parameters.

– Set **MEASURE** to **0 TO 1st**

– Increase **ZERO** until the correct sound path for the echo in the gate is displayed.

Straight-beam probe with delay

Calibration with straight-beam probes, which have a greater delay path, mainly corresponds to the above calibration for straight-beam probes which only have the protection layer as a delay path.

Unlike the above procedure, you have to start by making the following adjustments:

– Set **DELAY** and **ZERO** to 0

– Preadjust **ZERO** so that the first interface echo is at the zero point of the scale.

– Adjust **RANGE** so that, with a **known sound velocity,** the first interface echo and at least the first backwall echo appear, and, with an **unknown sound velocity,** at least two backwall echoes appear before the second interface echo.

– From this point, proceed the same as for both previous cases.

Calibration with angle-beam probes

Known sound velocity

In this case, it is sufficient when there is an echo from a known reflector with a known distance, e.g. the arc of the calibration block V1, V2.

– Enter known sound velocity **MTL VEL**

– Set Gate a to the first echo

– Set **ZERO** so that the correct value is displayed in the measurement line “S=...”.

Example:

Calibration of the 100 mm range for steel (trans) using calibration block V2

– Enter sound velocity **MTL VEL** (3255 m/s)

– Set **RANGE** to 100 mm.

– Set **DELAY** and **ZERO** to 0.

– Couple the probe and peak the first echo from the 25 mm radius of V2.

– Set Gate a to the first arc echo.

– Adjust **ZERO** so that “S=25" is displayed in the measurement line.

The display range is now calibrated. For the measurement you can now enter the values for **ANGLE, X-VALUE and THICKNESS**.

Unknown sound velocity

In this case you will require a calibration block made of the test material. A semicylinder is suitable for this purpose.

Couple the probe to the plane of section of the semicylinder with the radius R, and peak the first echo from the semicircle. An echo sequence occurs with the sound paths R, 3R, 5R, etc.

You apply these echoes for calibration the same as the backwall echoes described above which come from a plane-parallel calibration piece with vertical beaming.

Example:

Calibration on a semicylinder having a radius of R=50 mm at a test range of 200 mm.

– Set **RANGE** to 200 mm.

– Set **DELAY** and **ZERO** to 0.

– Set **MEASURE** to **MULTECHO.**

– Couple the probe and peak the echoes.

– Adjust the gate so that the first arc echo (→ 50 mm sound path) in Gate a and the second arc echo (→ 150 mm sound path) in Gate b are evaluated.

– Set the sound velocity **MTL VEL** so that "S=100" is displayed in the measurement line

– Set **MEASURE** to **0 TO 1st**

– Set Gate a to an echo

– Set **ZERO** so that "S=50" is displayed in the measurement line

The calibration has now been completed.

Calibration with a dual (T/R) probe

Above all, dual (T/R) probes are mainly used for thickness measurement. When applying these probes observe the following characteristics:

The FLANK mode

Most dual (T/R) probes have a roof angle (an element which is at an angle to the surface of the test object). Due to this, mode conversions occur with sound entry and at the reflection on the backwall which can cause rugged, wide echoes. This is the reason why you should always select **FLANK** in **TOF.**

In order to obtain steep increasing flanks, which enable a higher measurement accuracy, you can use the Reject function if necessary. In this regard, refer to the information on the **DAMPING** function.

V-path error

With dual (T/R) probes, there is a V-shaped sound path from the pulser to the receiver element via the reflection from the backwall. This "V-path" influences the measurement accuracy. Therefore, you should select two thicknesses which include the expected thickness range. The V-path error can be largely compensated in this way.

Higher sound velocity

Due to the V-path error, a higher sound velocity than the test material is required when calibrating, especially with smaller thicknesses. This is typical of dual (T/R) probes and acts as compensation of the V-path error.

Owing to the described effect there is a drop in the echo amplitude with smaller thicknesses which should be carefully observed with values < 2 mm.

A calibration block having different thicknesses must be used for calibration. The thicknesses are to be selected so that they include the expected measurement value.

– Set **PULSER** in the function group **PULS** to **DUAL**.

– Set **RANGE** according to the test task and the probe being used..

– Set **TOF** to **FLANK**.

– Couple the probe to the thinner part of the calibration block and peak the echo.

– Set the flank as steeply as possible by adjusting the gain.

– Set Gate a on the first echo.

– Set **ZERO** in the function group **S-CAL** so that the measurement line display the correct value at "S=...".

– Couple the probe to the thicker part of the calibration block and peak the echo.

– Set the flank as steeply as possible by adjusting the gain.

– Set Gate a on the first echo.

– Set the sound velocity "**C**" so that the correct value is displayed in the measurement line at "S=...".

Automatic calibration

The instrument has an automatic calibration capability via the function **AUTO CAL**. Two calibration echoes must be entered. The instrument then carries out a plausibility check and automatically sets the parameter.

– Set the function **AUTO CAL** in the second operation level (right function table) to **ON**.

– Return to the first operation level with ⊞ and select function group **S-CAL** with ◁ ▷.

The function group **S-CAL** changes in preparation for the automatic calibration and now contains the CAL function (calibration) as well as the function **S-REF** (sound path for the reference echo).

Operation:

– In the function **CAL** press ◄ and ► simultaneously. The function is now enabled.

– **REC 0** is displayed, indicating that no calibration echo has been recordet yet.

– Set the gate onto the first calibration echo and enter the sound path in **S-REF** using ◄►.

– Save the first calibration echo using ◄► in the **CAL** function. On the display: **REC 1**.

– Set the gate onto the second calibration echo and enter the sound path in **S-REF** using ◄►.

– Save the second calibration echo using ◄► in thte **CAL** function. On the display: **REC 2**.

– Press ► on **CAL** again to terminate the 2-step calibration procedure.

Automatic calibration is carried out after the instrument has calculated the entered parameters and made a plausibility check.

☞ **Note**:

To verify a correct instrument calibration, always check the setting using the echo of a known distance, other than those used for calibration.

Preparing the instrument for digital measurement

USN 52R/USN 52L must be calibrated to the material to be tested in order to give the correct measurement readings.

☞ **Note:**

For all calibration procedures, use a calibration block with a known thickness, made of the same material and having the same temperature as your test object.

Preconditions:

To start with, calibrate the A-scan display as described in the preceding section. Carry out the following basic settings:

GATE LOGIC:
POSITIVE, NEGATIVE or MEASURE

MEASURE: 0 TO 1st – for measurement to the first echo in the gate. By this, the thickness or the flaw position can be measured.

MEASURE: MULTECHO – for measurement between the first echoes in the gate sections. Above all, this setting is suitable for thickness measurement in the multiecho sequences.

TOF: According to the application.

Calibrating the sensitivity – dB REF

dB REF is of great help for sensitivity calibration. With dB REF you store a reference echo as a basis for your measurement and amplitude evaluation. Gain differences in dB between the amplitudes of any echoes and the stored echo are directly displayed in the measurement line as "H=".

Operation:

– Couple the probe and peak the reference echo,

– Adjust the gain so that the echo reaches the required height.

– Position Gate a on the reference echo. This must be the highest echo in the gate,

– Press dB REF. The reference echo is now stored. The value is reset by pressing again.

Recall of dB difference:

– Set **AMPLITUDE** to **dB THRESHOLD**.

– Position the gate onto the required echo.

The dB difference is now displayed in the measurement line. It indicates the dB amount by which the flaw echo falls below or exceeds the reference echo.

5.4 DAC/TCG

The **DAC/TCG** function enables you to:

- record a Distance-Amplitude Curve and to store it as an essential part of the current data set.
- display the Distance-Amplitude Curve (DAC) of the reference echoes.
- activate the Time-Corrected Gain (TCG) which increases the gain as a function of distance so that all reference echoes attain the same height. The amplitude evaluation of echo indications is now carried out in relation to the first reference echo.
- activate the TCG as above, however, with simultaneous representation of the DAC/TCG function.

Due to the angle of beam spread of the sound beam and the sound attenuation in the material, the echo height of equally sized reflectors depends on their distance to the probe.

The DAC/TCG in the USN 52R/USN 52L can correct these influences.

In this regard, the gain is varied as a function of the time of flight in such a way that the echoes appear equally high on the display irrespective of their distance.
This means that the echo amplitude now only depends on the reflection characteristic of the flaw.

If you use a calibration block provided with artificial flaws corresponding to the natural flaws of your test object for recording the DAC, you can use this echo amplitude for the evaluation of the reflector without having to make any other corrections. The calibration block should be made of the same material as the test object.

Each artificial flaw is scanned, the echo is peaked and then recorded.

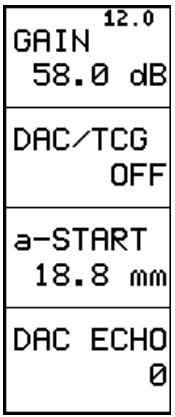
The DAC brings the echo sequence to 80% screen height. During this, the instrument sets the gain to the gain value of the highest echo.

The maximum dynamic range is 40 dB;
the maximum slope of the curve is 6 dB/µs;
the maximum number of curve points is 9.

Function group TCG

With these functions you can operate all DAC/TCG modes.

Use ▷ to go to the function group **TCG**:



DAC/TCG mode

With this function you can determine the DAC/TCG mode:

OFF: No DAC/TCG is active.

DAC: The already stored Distance-Amplitude Curve is displayed on the screen.

TCG: The TCG is calculated on the basis of the curve so that all reference echoes reach the same screen height: TCG (=Time-Corrected Gain).

Echoes from the test object are now evaluated in relation to a reference echo.

☞ Note:

- With active **TCG** the symbol **T** is displayed in the status line.
- In the **TCG** setting, the lowest function **DAC ECHO** changes to **CURVE**.
  You can additionally have the progress of the gain increase displayed by a curve at this point if you wish: CURVE = ON.

- The two settings **DAC** and **TCG** can only be switched on if a curve was recorded beforehand, or if a data set containing a curve was recalled.

REC: Use this setting to prepare the instrument for the recording of a DAC curve. A curve that possibly already exists is deleted.

a-START: With this, you can determine the starting point of the gate (please also refer to function group **GATE**). This function is repeated here because it is required for recording a curve and for the echo evaluation.

DAC ECHO: The **DAC ECHO** function shows the number of curve points (reference echoes) and is used in the recording mode (REC) for recording the next reference echo.

Operation:

Before starting to record a reference curve, you have to carry out a correct instrument calibration first. This especially applies to the functions: **RANGE, MTL VEL, FREQ., RECTIF.** and **DAMPING** due to the fact that a variation of these functions is no longer possible with an active **DAC** or **TCG**.

5.5 Recording a Distance-Amplitude Curve

Attention:

Recording of a new curve will delete a curve that possibly already exists. If necessary, make sure that the old curve is stored in a free data set before you start recording a new curve!

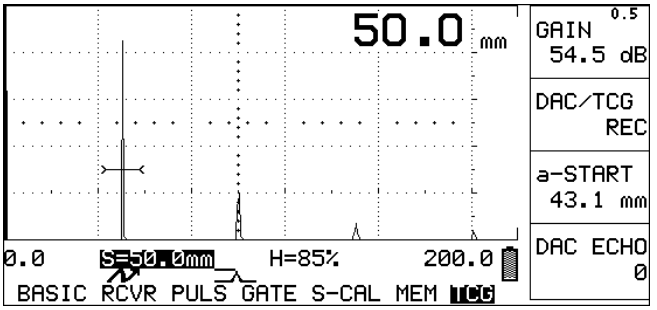
Use ▷ to go to the function group **DAC**.

– Press the ◁▷ keys simultaneously to switch the **DAC/TCG** function to the record mode: DAC/TCG = REC.

– The **DAC ECHO** function is at 0 as no echo has been recorded yet.

– Couple the probe to the reference block and peak the first reference echo. Bring the echo with Gain to about 80% screen height.

– Move the gate onto the corresponding echo with **a-START**. The gate threshold must be adjusted so that the echo exceeds it.

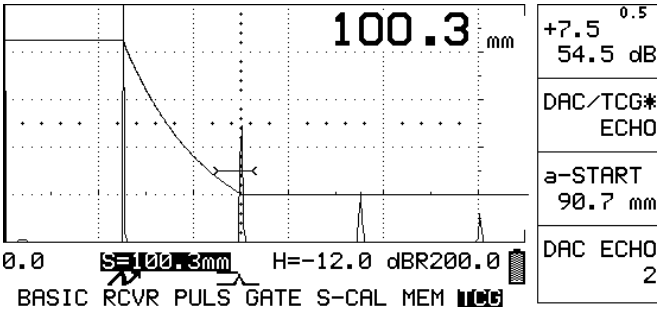


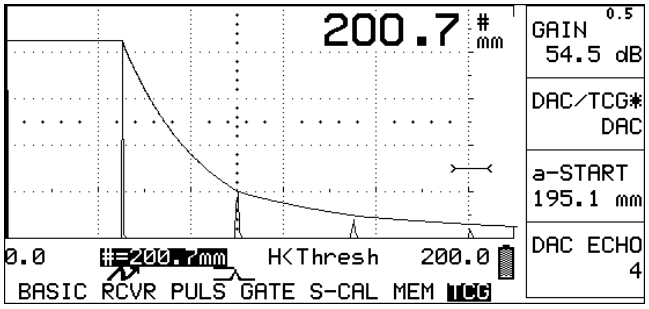
– Switch on **DAC ECHO** now:
All reference echo data (sound path, amplitude and gain setting) are stored in the instrument, and the **DAC ECHO** function shows the number 1.

– Peak the next reference cho.

– Position the gate onto the echo and readjust the gain if required until the echo exceeds the threshold.

– Switch on the **DAC ECHO**:
The data of the second echo are stored - DAC ECHO = 2.
You will now already recognize that there is a curve between the amplitude of the first echo and the gain-corrected amplitude of the second echo.





– Continue to proceed in this way until all available reference echoes are recorded.

– Switch on the curve now by setting the **DAC/TCG** function to **DAC**:
The record mode is automatically switched off, the curve is displayed, and all echo indications can be evaluated relative to this curve.

☞ Note:

The **DAC/TCG** function is now marked with "*" indicating that the current setting contains a DAC curve.
The marking DAC/TCG* also appears when the function is switched off.

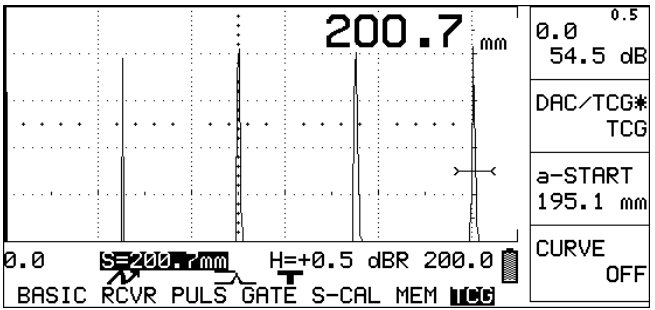
– If you require an evaluation in the TCG mode, switch the **DAC/TCG** function over to **TCG**.
All reference echoes will now be at approx. 80% screen height. At the same time, you can now have a graphic display of the gain increase with the **CURVE** function.

– All echoes will from now on be evaluated in relation to the reference height (dBR); this is the height of the first reference echo.

– To be on the safe side, store this setting in a free data set.

Note:

If the DAC/TCG is active, the symbol **T** is additionally displayed in the status line:

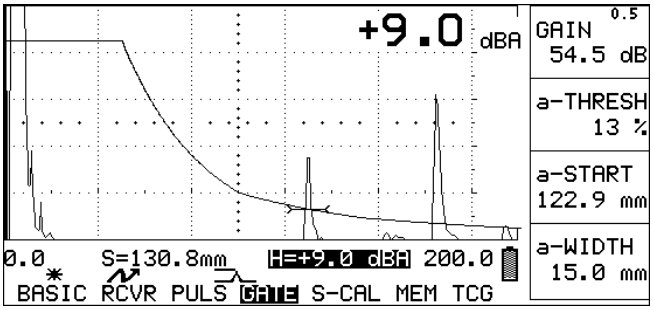


5.6 Echo evaluation with DAC/TCG

To be able to evaluate a flaw indication by means of the DAC/TCG, certain requirements have to be met:

- The Distance-Amplitude Curve must already be recorded.
- It *only* applies to the same probe that was used for recording the curve. Not even another probe of the same type must be used!
- The curve and the DAC/TCG *only* apply to the material that corresponds with the material of the reference block.
- All functions affecting the echo amplitude must be set as they were during recording of the curve. This especially applies to the following functions: **DAMPING, FREQ.,RECTIF., MTL VEL, PULSER** and **REJECT**.
- **TOF** is set to **PEAK**.
- **AMPLITUDE** is set to **dB THRESHOLD**.
- Choose the echo amplitude (as dB difference to the curve) using the ◀ ▶ -keys for an enlarged representation in the A-scan.

DAC mode



– Peak the echo of an assumed flaw and shift the gate so that the echo data are evaluated.

– You can read the sound path in the measurement line and, in addition with angle-beam probes, the (reduced) projection distance and the flaw depth. You can immediately see from the A-scan whether or not the echo has to be recorded.

The recording threshold violations in dB can also be easily determined:

– Adjust the gate threshold exactly to the point of intersection of the curve with the assumed flaw indication.
The enlarged reading in the A-scan indicates the amount of dB by which the flaw echo exceeds the curve, i.e. the amount by which the echo indication exceeds the reference echo.

TCG mode

⚠ Attention:

An echo amplitude evaluation as measurement of the difference to the reference echo is only possible if the reference height (height of the first reference echo) stored during the reference echo recording still applies. If another echo is stored as reference echo with [dB-Ref] after recording of the curve, the original reference echo is lost.

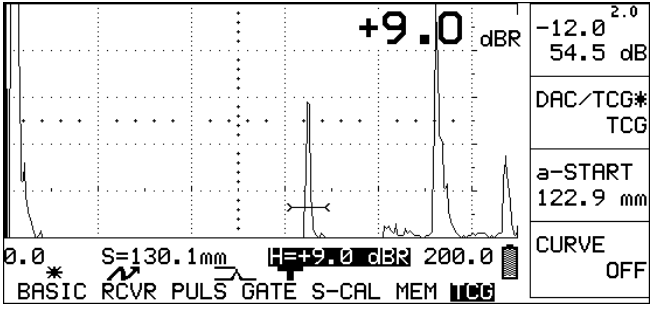
If this is the case, then you need for a flaw evaluation again the reference block with which the Distance-Amplitude Curve was recorded.

After switching-on of the TCG mode, all echoes from the reference flaws reach the height of the first reference echo. In addition, you can position the gate over the entire evaluation range so that each echo is directly measured.

– Peak the echo from an assumed flaw. If necessary, increase the gain until the echo exceeds the gate threshold.

– You can read the sound path in the measurement line and, in addition with angle-beam probes, the (reduced) projection distance and the flaw depth. The enlarged reading in the A-scan (dBR) indicates the amount in dB by which the flaw echo exceeds or falls below the reference echo.

The result of an amplitude evaluation is not affected by a gain variation, i.e. the indicated gain difference dBR is always the difference between the flaw echo and the reference echo.



5.7 Measuring thickness

USN 52R/USN 52L enable you to measure thickness and distance in a simple way. The measured value is directly displayed. One of the following two methods of measurement is used, depending on the application:

- Measurement to the first echo – e.g. corrosion measurement with a dual (T/R) probe
- Measurement of the multi-echo sequence with a single- element probe on a test object which has a good surface on both sides

Preparations

– Select probe

– Set **MEASURE** (refer to previous section)

– Select **TOF** (refer to Page 5-9)

– Calibrate A-scan display

– Calibrate the USN 52 R for the selected probe and the measurement mode (refer to previous section)

Measuring the thickness

– Clean the surface of the test object from dirt and any loose particles

– Apply couplant to the surface of the test object

– Using slight and even pressure, couple the probe

– Observe A-scan display and S=...”-value until the measured value display is stable

– Maximize the echo amplitude

– Read measured value

Note:

If you are operating with **MULTECHO** in **MEASURE**, observe Gate b in order to evaluate the correct echo.

You can store the displayed measurement values in the Data Logger or transfer them into another instrument via the RS232 interface.

5.8 Storing measured values - Data Logger

The Data Logger helps you to store and manage your measurement results. These are saved even when the batteries are removed. The stored measured values can be:

- displayed
- deliberately deleted
- transferred to a peripheral
- output via a PC or printer

A number of measurements are compiled into one “FILE”. To file measured values in the Data Logger you must

- determine the required number of FILES
- select a FILE

Determining the number of FILES

You determine the total number of FILES (max. 99) – the instrument automatically determines the number of measurement locations according to the following formula:

Number of measurement locations = 2500 : Number of FILES

The first measured value of each FILE is automatically allocated the number 1. However, you can also select another measurement location. All the following measured values are consecutively filed until all measurement locations are full or until you select another FILE or measurement location.

Note:

You can only determine the number of FILES when the Data Logger is empty.

Operation:

– Change to the second operating level and select the function group for the Data Logger.

– Set the required number of FILES in **FILE NUMBER:** SET #01 = 1 FILE, SET #02 = 2 FILES, etc.

– Simultaneously press ◄ ► when the required number is displayed. The memory is correspondingly set up.

You can store the measurement results. The Data Logger has the following presettings:

FILE MODE:	THICKNESS
MEASURE:	0 TO 1st
GATE LOGIC:	POSITIVE
COPY MODE:	DATA LOGGER

Selecting a FILE

If the instrument was switched off or if the Data Logger was selected, then the FILE number last selected is automatically active. In order to select another number:

Operation:

– Change to the second operating level and select the function group of the Data Logger.

– Set the required number in **FILE NUMBER.**

The active status of each FILE number is displayed:

EMPTY:
File is empty.

ACTIVE:
File contains at least one reading.

FULL:
All measurement locations in this FILE are allocated.

ALL CLEAR:
You must first enter the number of FILES.

Clearing FILES

All cleared data are irrevocably lost. Therefore, transfer the data to a PC or printer beforehand if necessary.

Operation:

– Change to the second operating level and select the function group for the Data Logger.

– Select the data set in **FILE NUMBER** which you wish to delete. Select **ALL CLEAR** to completely delete the Data Logger.

Attention:

All deleted data are irretrievably lost!

– Simultaneously press ◄ ► in **FILE NUMBER** and keep it pressed for about 3 seconds.

When the FILE status “EMPTY” or “ALL CLEAR” is displayed, the selected FILE or the complete contents of the Data Logger are cleared.

Storing measured values

A measured value is only stored if it is not equal to 0 and if the active measurement location is empty. To start with, set the following values:

FILE NUMBER: EMPTY or ACTIVE
FILE MODE: THICKNESS
COPY MODE: DATA LOGGER
MEASURE: 0 TO 1st or MULTECHO

The thickness value is displayed in the A-scan mode at the top right-hand side. The measurement line shows:

- **LOC:** the memory slot number of the selected FILE. The next measured value will be stored here.
- **VAL:** the value which is stored on the displayed measurement location.

Operation:

Press ⋮ to store the measured value.

Note:

You should transfer data to a PC in order to save them permanently. You can order the software which is required for data transfer from Krautkrämer (refer to Chapter 2).

Viewing stored readings

You can select each measurement location and have the values displayed which are stored there. The following appear as measurement location status:

EMPTY:
no measurement stored

x.xx mm:
the stored values in the active units of measure

ERROR:
erroneous measured value. Storing must be repeated.

Operating in the A-scan mode:

Measurement location number (LOC) and value (VAL) are displayed in the measurement line.

– With ◀ or ▶ select the required measurement location. The value stored there appears at **VAL.**

Operation from the second operating level:

– Select the function group containing the Data Logger.

– Using ◀ or ▶ select the required measurement location when in **LOCATION.** The value stored there is displayed in **VALUE**.

Clearing the measured values

You can clear the displayed reading and, if necessary, store a new value at this measurement location.

Operation in the A-scan mode:

– Select the value to be cleared as described above.

– Simultaneously press ◀ ▶ and keep the keys pressed for about 3 seconds.

When **VAL**: EMPTY appears, then the measured value is deleted.

– If necessary, press ⋮ in order to store a new value at this measurement location.

Operation from the second operating level:

– Select the value to be deleted, as described above.

– When in **VALUE,** simultaneously press ◀ ▶ and keep the keys pressed for about 3 seconds.

When **VALUE**: EMPTY appears, the measured value is deleted.

– Press ⋮ in the A-scan mode to store a new value at this measurement location.

5.9 Configuring the USN 52R/ USN 52L

In the second operating level you will find all functions which do not have a direct influence on the A-scan. They are compiled into two function tables.

– Press ⊞ to change from the first to the second operating level and back again.

The currently active table of the lower operating level appears.

– Press ◀ or ▶ to change between function tables of the second operating level.

Left Table

Left function group

GRATICULE	Display graticule on/off
AMPLITUDE	Amplitude reading
FREEZE MODE	Storage mode
INTENSITY,	Display brightness (only USN 52R)

Center function group

VELOCITY # 1	Sound velocity for coarse mode
VELOCITY # 2	Sound velocity for coarse mode
dB STEP	Step range for
GATE LOGIC	Evaluation logic and on/off

Right function group

FILE NUMBER	All functions are used for adjustment of
LOCATION	the Data Logger in order to store and
VALUE	recall the measured values.
FILE MODE	

Center Table

Left function group

A-SCAN	Hollow or solid echo signal display
LANGUAGE	Display language
DATA SET DIREC	Directory of all data sets
DATA SET NAME	Entry of data set names

Center function group

BAUD RATE	All functions are for adjustment of the
LENGTH	RS232 interface and for the copy
PARITY	mode, e.g. for transfer to the
COPY MODE	Data Logger

Right function group

ANGLE	All functions are
THICKNESS	used for calculation
X-VALUE	of the
O-DIAM	flaw position.

Right Table

Left function group

AUTO CAL	Display graticule on/off
GATE LOGIC	Amplitude reading
MEASURE	Storage mode
TOF	Display brightness

Center function group

AMPL.EVAL.	Switching between DAC/TGC and DGS
MEMO	MEMO function on/off
MEAS.UNITS	Selection of units

GRATICULE Display graticule

In this function you either switch the display graticule on or off. In doing this, you are able to directly read off the echo positions and heights.

Operation:

– Highlight the left function group in the left function table with ◁▷.

– Enable or disable **GRATICULE** with ◂▸. The currently active setting is displayed.

AMPLITUDE Amplitude display

In this function you determine how the amplitude of the highest echo is to be displayed in the gate. This appears in the measurement line as an “H = ...”-value. You have the following possibilities:

- **% Screen HT:** A percentage of the screen height
- **dB THRESHOLD:** (dB REF not active) expressed as a dB difference relative to the gate threshold
- **dB THRESHOLD:** (dB REF active) expressed as a dB difference relative to the stored reference echo amplitude

Operation:

– Highlight the left function group in the left function table with ◁▷.

– With ◂▸ select the required setting.

FREEZE MODE Storage mode

In this function you determine which display contents you wish to store:

- **FREEZE ALL:** the complete A-scan presentation is stored.
- **FREEZE PEAK:** the highest echo amplitude is stored.

Operation:

– Highlight the left function group in the left function table with ◁ ▷.

– With ◂ ▸ select the required setting**.**

INTENSITY Display brightness (only USN 52R)

You are able to adjust your USN 52 R to different ambient light conditions. To do this, you can switch between two brightness positions:

- **HIGH**
- **LOW**

Operation:

– Highlight the left function group in the left function table with ◁ ▷.

– With ◂ ▸ select the required setting**.**

Note:

Please consider a higher power consumption with **INTENSITY** = **HIGH** which reduces the battery life.

VELOCITY #1 / VELOCITY #2 Preselecting fixed values for sound velocity

When calibrating the display range, you can select between two fixed sound velocity values in the coarse mode.

In this function you determine which values are available for selection.

- You can set the sound velocity between 1000 m/s and 9999 m/s (continuously adjustable).

Operation:

– Highlight the center function group in the left function table with ◁ ▷.

– With ◂ ▸ set the required values in **VELOCITY #1** and **VELOCITY #2.**

☞ Note:

The preset default values here are as follows:

- 5918 m/s for longitudinal sound velocity
- 3353 m/s for transverse sound velocity

dB STEP Sets step range

You can set the gain with five different step ranges. In this function you enter your own value for the adjustable step.

- You are able to enter a step range between 6.5 dB und 24.0 dB in steps of 0.5 dB.

Operation:

– Highlight the center function group in the left function table with ◁ ▷.

– With ◂ ▸ set the required step range.

GATE LOGIC Setting the gate logic

In this function you can activate the gate and select the criteria for triggering the gate alarm. The following settings are available:

- **OFF:** The gate is disabled. The gate bar is not displayed.
- **POSITIVE:** The gate is enabled. When the signal exceeds the threshold that was preset in **a-THRESH**, the two LEDs will flash alternately.
- **NEGATIVE:** The gate is enabled. When the signal falls below the threshold that was preset in **a-THRESH**, the two LEDs will flash alternately.
- **MEASURE:** The gate is enabled. However, there is no alarm with threshold violation.

Note:

You can select either POSITIVE, NEGATIVE or MEASURE for digital thickness measurements.

Attention:

Both gates only evaluate within the visible part of the display range. If there are gates or parts of gates outside the visible part of the display range, then a gate evaluation will not be made there.

Operation:

– Highlight the center function group in the left function table with ◁ ▷.

– With ◂ ▸ select the required gate setting**.**

FILE NUMBER Selecting a file

In this function you enter the number of FILES for the Data Logger. You can also select specific measured values here. The indicated functions are:

- **ALL CLEAR:** No files have been configured
- **FILE NUMBER # 1-99:** Enter number of files
- **ALL FILES:** When there are configured files
- **EMPTY:** (before file number) No reading stored
- **ACTIVE:** (before file number) Reading stored
- **FULL:** (before file number) No measurement locations free

Operation:

– Hightlight the right function group in the left function table with ◁ ▷.

– With ◂ ▸ select the required setting.

Note:

More detailed information about operation of the Data Logger can be found in Chapter 5.5.

LOCATION Selecting the measurement location

Set the measurement location at which the next measured value is to be stored.

Operation:

– Highlight the right function group in the left function table with ◁ ▷.

– With ◂ ▸ select the number of the required measurement location.

– If you wish to return to **LOCATION** 1, press ◂ and ▸ simultaneously.

VALUE Displaying the measured value

The measured value at the selected location is displayed:

- **EMTPY:** No reading stored
- **xx.x mm:** The stored reading

Clearing the measured value:

– Highlight the right function group in the left function table with ◁ ▷.

– If necessary, press ◂▸ for about 3 seconds in order to clear the displayed reading.

FILE MODE Enabling the Data Logger

In **FILE MODE** you can enable or disable the Data Logger:

- **OFF:** Data Logger is disabled.
- **THICKNESS:** Data Logger is enabled.

Note:

You can only enable the Data Logger when **DATA LOGGER** is selected in **COPY MODE** (right function table).

Operation:

– Highlight the right function group in the left function table with ◁ ▷.

– With ◂▸ alternately enable and disable the Data Logger.

LANGUAGE Setting the display language

In **LANGUAGE** you can select the dialog language for interactive communication with the instrument. The following languages are available:

- German
- English
- French
- Italian
- Spanish
- Portuguese
- Swedish
- Danish
- Norwegian
- Finnish
- Dutch
- Russian

Operation:

– Highlight the left function group in the center function table with ◁ ▷.

– Select the required language with ◂ ▸.

MEAS. UNITS Setting the measurement units

In this function you enter the measurement units in which the instrument is to operate. You can select between METRIC or INCH.

Operation:

– Highlight the left function group in the center function table with ◁ ▷.

– Select the required measurement unit with ◂ ▸.

☞ Note:

If the measurement units are changed at a later time, the values are automatically converted. However, in order to work with “rounded off” values, you should set the measurement units at the beginning of the test.

5.10 Data set names

Data set names

You can give the instrument settings (data sets) alphanumeric names which are also stored. In doing this you are able to identify your data.

The data set number remains the clear identification (e.g. with the application of data transfer software).

The names can consist of up to a maximum of 8 characters.

MEMO function

The **MEMO** function of the instrument gives further possibilities for a better documentation of test results (data sets). You can either type and store a text (max. 80 alphanumeric characters) for each data set, or you can fill in data in predefined fields which are likewise stored together with the data set. Unlike the text that can be freely edited, a data header is structured and consists of individual fields which are automatically or manually filled in with additional information. You can determine the structure of the header (number of fields, field lenghts and field names) by means of remote control commands. You can define so-called active fields which are automatically filled in with data (e.g. sound path or amplitude) from the currently active A-scan.

When the **MEMO** function is switched on, the menu for the entry of additional data (texts or header data) appears each time a data set is stored. This menu is always also accessible via the second operating level.

To use the **MEMO** function, you have to:

– switch the **MEMO** function on,

– define a header by means of remote control commands if necessary.

Note:

You will find the remote control commands in chapter 8.7.

DATA SET NAME Entry of a data set name

This function is used for entering the data set name.

Operation:

– Highlight the left function group in the center function table using ◁▷.

– Select the required data set number with ◂▸.

– Simultaneously press ◂ and ▸ allocated to the function **DATA SET NAME**.

You will see the following display:

```
DATA SET NAME                    DATA SET  1

1 2 3 4 5 6 7 8 9 0 . # * - / A B C D E F

SPA G H I J K L M N O P Q R S T U V W X Y Z
```

The cursor flashes at the entry position of the inverted field of the menu.

In the two lower lines you will see letters, numbers and characters which you can use for the data set name.

To enter the required text, start by selecting the entry position in each case, and then select the character which should be inserted at this position.

The entry position and character are always marked by a flashing cursor. You can enter all required characters in any chosen order.

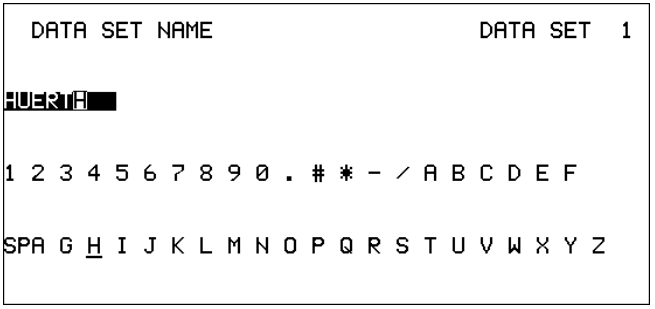
– Press the keys ◀ or ▶ in order to change the entry position.

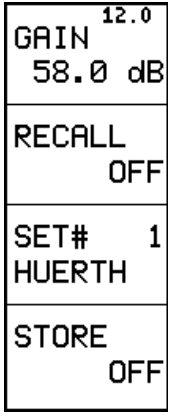
– Press the keys ◂ or ▸ next to the corresponding character string in order to select a character. The flashing cursor changes the string automatically. The highlighted character is immediately inserted at the entry position.

– Finally, press the key ⊞ to store the entries.

The data set name is now stored together with the data set number and also appears in the function group **MEM** in the first operating level.

You can overwrite characters that have already been entered simply by marking the corresponding position and selecting another character.





DATA SET DIREC Data set directory

In this function you obtain a quick overlook over all stored data sets with their names and numbers.

Operation:

– Mark the right function group in the center function table with ◁ ▷.

– Switch on the function **DATA SET DIREC** with ◂▸.

A total of 12 data sets are displayed.

– A further group of 12 data sets is displayed using the ◀ ▶ keys; ▶ selects the following group, ◀ the previous group.

You can select one of the displayed data sets in the directory:

– Mark the column with ◁ ▷.

– Press the corresponding ◂▸ keys.

The directory function is exited; the selected data set is now entered into the left-hand function group in the function **DATA SET NAME**.

Using the function group **MEM** in the first operating

level and the function **RECALL** you are able to load this data set as usual. The directory function can be exited at any time by pressing ⊞ or ↖.

MEMO Storing additional information

You can store additional information on every data set, either as freely formulated text (max. 80 alphanumeric characters) or by filling in predefined fields of the data header.

If the **MEMO** function is activated, the menu for entering additional information (texts or header data) appears each time a data set is stored. This menu is always also accessible via the second operating level.

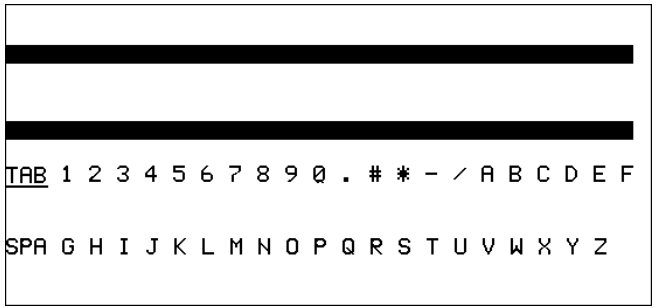
Operation:

– Select a data set as described in the previous section.

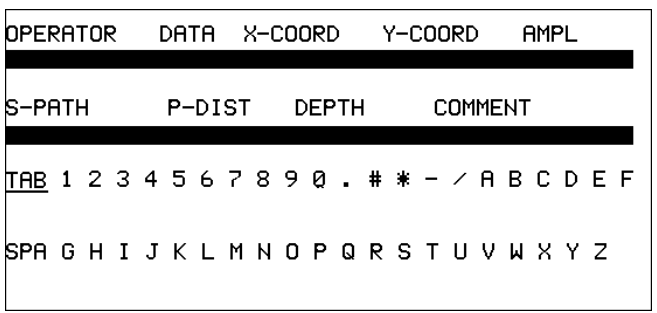
– Highlight the center function group in the right-hand function table with ◁ ▷.

– Press ◂ and ▸ simultaneously for the function **MEMO**. You will see the menu for the entry of additional information allocated to the selected data set.

If USN 52R/USN 52L are set to the entry of freely formulated texts, you will see the following display:



If a data header was defined for the entry of additional information, you will see e.g. this display:



The cursor flashes at the entry position.

Entering texts

In the two lower lines you will see letters, numbers and characters that you can use for the texts. To enter the required text, start by selecting the entry position in each case, and then select the character that should be inserted at this position. The entry position and character are each marked by a flashing cursor. You can enter all required characters in any chosen order.

Note:

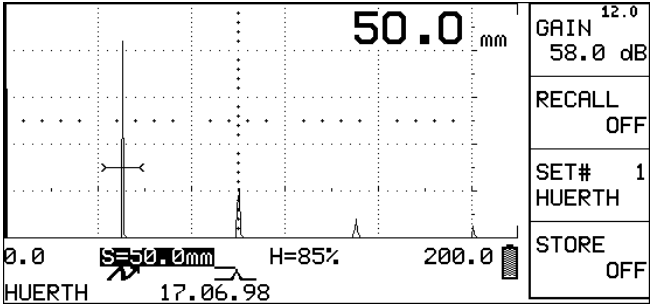
You only need the TAB character for the entry in a data header.

– Press the keys ◀ or ▶ to change the entry position.

– Press the keys ◄ or ► next to the corresponding character string in order to select a character. The flashing cursor changes the string automatically. The highlighted character is immediately inserted at the entry position.

– Finally, press the key ⊞ to store all entries.

The additional information is now stored together with the data set number. If the **MEMO** function was used for the selected data set, you will see the first 46 characters of the entered additional information instead of the menu bar in the **PREVIEW** mode (the first operating level).



Filling in a data header

In the two lower lines you will see letters, numbers and characters that you can use for the texts.

Above it, you will see four other lines: two lines containing the labelings of the selectable fields, each of the lines below them are used for text entries. Depending on the data header configuration, some fields are already automatically filled in with data from the currently active A-scan. You cannot select these fields.

To enter the required text, start by selecting a field and then the entry position in each case, and continue by selecting the character to be inserted at that position.

The entry position and character are always marked by a flashing cursor. You can enter all required characters in any chosen order.

Operation:

– Press the keys ◁ or ▷ next to the corresponding character string in order to select a character. The flashing cursor changes the string automatically. The highlighted character is immediately inserted at the entry position.

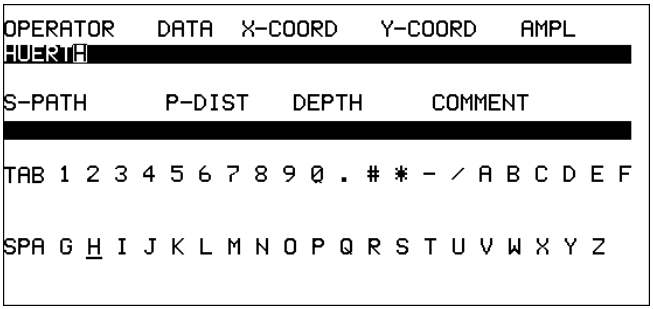
– Press the keys ◀ or ▶ to change the entry position within a field.

– Use the keys ◄ or ► to select the TAB character. The cursor flashes under TAB.

– Press the keys ◄ or ► next to the entry strings to select another field. The flashing cursor changes the string automatically. Fields that are automatically filled in with data cannot be selected, and they are skipped.

– Press the keys ◄ or ► next to the corresponding character string in order to select a character. The flashing cursor changes the string automatically. The highlighted character is immediately inserted at the entry position.

– Finally, press the key ⊕ to store all entries.



5.11 Setting the RS232 interface

In the center function group of the right table you will find all functions for setting the serial interface RS 232.

If you connect a peripheral to the instrument via the RS232 interface, you must always ensure that both interfaces are configurated the same. This is the only to guarantee error-free communication.

You can make the following settings for data transfer (the default setting is indicated in **bold** type):

BAUD RATE Setting the transfer speed

- 300 Baud
- 600 Baud
- 1200 Baud
- 2400 Baud
- 4800 Baud
- **9600** Baud

LENGTH Setting the length of a byte

- 7 DATA BITS
- **8 DATA BITS**

PARITY Parity check

- **DISABLED**
- EVEN
- ODD

Operation:

– Highlight the center function group in the center function table with ◁ ▷.

– With ◂ ▸ select the required setting for **BAUD RATE, LENGTH** and **PARITY.**

Note:

Also refer to the information about interfaces in Chapter 8.2

COPY MODE Setting data communication

In this function you select the data transfer mode when you press ⋮:

- **HARD COPY**:
  Printout of complete display
- REPORT:
  Printout of Data Logger report
- THICKNESS:
  Transfer of thickness value
- DATA LOGGER:
  Prerequisite for enabling the Data Logger
- DISP + PDUMP:
  Printout of A-scan and report
- PARAMETER DUMP:
  Printout of parameter dump with remote codes and actual settings.
- MEMO DUMP:
  Printout of the additional informations of the MEMO function.

Operation:

– Highlight the center function group in the center function table with ◁ ▷.

– With ◂ ▸ select the required setting in the **COPY MODE.**

Printer type

Additionally, you select in this function the printer for which the printouts are formatted:

- **EPSON FX** (also for EPSON LX-300)
- SEIKO DPU 411 (also for Seiko DPU 414)

Operation:

– Simultaneously press ◂ and ▸ in the function **COPY MODE**.

The function changes in **PRINTER SELECT**.

– Select the required printer driver with ◂ ▸.

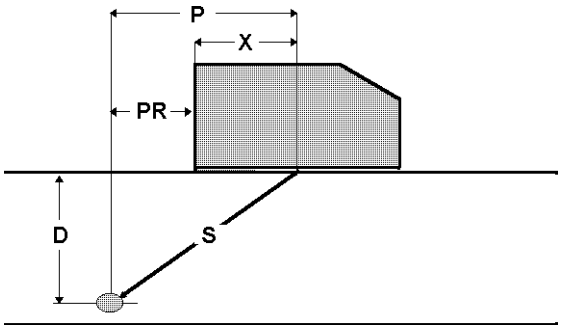
– Simultaneously press ◂ and ▸ again in order to exit this function.

5.12 Setting the flaw location calculation

When using angle-beam probes, the flaw location can be automatically calculated. The following values are indicated on the display:

- **Sound path**
- **Reduced projection distance:** The distance from the front edge of the probe to the location of the flaw, projected on the surface
- **Depth:** Distance from flaw location to surface

The illustration on the next page shows the relationship between these values.



P projection distance
PR reduced projection distance
X distance probe edge – beam index point
S effective sound path
D distance flaw location – surface

Note:

The gate must be enabled and the **MEASURE** function set to “0 TO 1st“.

– With ◀ ▶ go to center function table.

All the necessary functions are available in the right group.

ANGLE Angle of incidence

You must set the value of the applied probe in order to enable automatic flaw location evaluation.

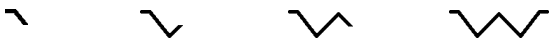
Operation:

– Set the required angle with ◂ ▸ in **ANGLE** (minimum 10°).

– In order to disable the flaw location calculation, press ◂ and ▸ simultaneously or set the function to OFF.

Note:

If you are working with an angle-beam probe and set the **ANGLE** function then, depending on the number of echo reflections, a symbol will be displayed in the status line:



THICKNESS Material thickness

To determine the true depth, you must enter the thickness of the material.

Operation:

– Set the thickness with ◂ ▸ in the **THICKNESS** function.

X-VALUE X-value of the probe

In this function you set the distance from the beam index point to the front edge of the probe (refer to the diagram on the previous page). This is determined mechanically with a ruler. The setting of the X-value is necessary when the instrument is to determine the reduced projection distance.

Operation:

– Set the X-value with ◂ ▸ in the **X-VALUE** function.

O-DIAM Test object diameter

You need the function **O-DIAM** if you are dealing with circular curved surfaces, e.g. when testing longitudinally welded tubes. To enable the instrument to make the corresponding correction of (reduced) projection distance and depth, you have to enter the outside diameter of the test object at this point.

If you want to make the flaw position calculation for plane-parallel test objects, the function **O-DIAM** has to be set to **infinite**.

If **O-DIAM** is set to a value other than **infinite**, the following status indicator will appear on the screen:

Operation:

– Use ◄ ► to set the outside diameter of the test object in **O-DIAM**, or select **infinite** if you are testing plane-parallel test objects.

Note

You can select **infinite** directly by simultaneously pressing ◄ and ► .

Displaying the measured values

The determined values are displayed in the measurement line:

S = Sound path
D = Depth
PR = Reduced projection distance, this is displayed when X-VALUE is not 0.

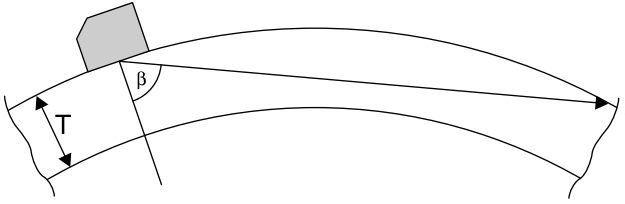
Otherwise this will read:

P = Projection distance.

– With ◄ ► select the value which is to be indicated in enlarged figures on the display.

Note

No values for P, PR and D are displayed if, according to geometrical conditions, the sound beam does not hit the inner surface of the workpiece.



Automatic calibration

The functions for automatic calibration are in the “right“ function table:

AUTO CAL **Switches on automatic calibration**

GATE LOGIC **Sets the gate for calibration**

Description of automatic calibration can be found in Chapter 5.

How to change values of the gate settings please refer to chapter 5.2.

5.13 Setting the measurement methods

MEASURE **Method of measurement for sound path measurement**

With this function you can select a method for the sound path measurement in the gate range. You have three possibilities:

- **OFF**: No measurement
- **0 TO 1st**: Measurement from zero point to the first or the highest echo above the threshold
- **MULTECHO**: Measurement between the first two echoes or between the two highest echoes above the threshold

Operation:

– Highlight the right function group in the left function table using ◁ ▷.

– With ◂▸ select the required setting in **MEASURE**.

Note:

The measurement results are displayed in the measurement line. The corresponding symbol will appear in the status line:

TOF Measurement mode for time of flight

In this function you can select the mode of measurement for the time of flight/distance within the gate. You have two possibilities:

- **Flank**: You measure the time of flight up to the first echo (at the first intersection point with the gate).
- **Peak**: You measure the time of flight up to the highest echo at the maximum amplitude.

If there is a distinct maximum amplitude, you should always select the setting **Peak**, because in that case the readings are independent of the set gain. You will avoid node errors (e.g. half-wave jumps at the echo flank). The measurement mode **Peak** is only possible if the amplitude to be evaluated is < 110% screen height. You must have selected the same **TOF** setting for the calibration.

Note:

With the setting **Flank,** the time of flight is derived from the first echo and the amplitude is derived from the highest echo within the gate.

Operation:

– Use ◁ ▷ to highlight the left function group in the right function table.

– Select the required setting **Flank** or **Peak** in **TOF** using ◂ ▸.

Note:

The measurement results are displayed in the measurement line. The corresponding symbol will appear in the status line:

5.14 🔒 – Locking set values

You are able to lock all set values against any unintentional or undesired adjustment.

Operation:

– Press 🔒.

All functions, with the exception of **GAIN** and **FREEZE MODE** (✱), are locked.

– When you press 🔒 once again, the functions are unlocked.

5.15 Function check

Using the following check list, you are always able to carry out an instrument function check.

If you should find an error or defect, send the complete instrument, together with a brief description of the roblem, to the nearest authorized Krautkrämer After-Sales Service.

Auxiliary devices:

- Calibration standard N30
- Probe CLF 4 and cable MPKM 2 (for resolution test)
- Batteries and/or Power Supply/Charger unit

☞ Note:

1 vertical scale division (Div.) corresponds to 10% screen height (SH).

Check	Result	Remark
1. Power supply		
Turn on instrument	Both LEDs light. The Krautkramer logo appears after 2 seconds. A-scan appears after 4 seconds.	
	Display and LEDs remain blank.	Power unit has no supply. Batteries are discharged – charge immediately.
2. Display		
Connect calibration standard N30: RANGE: 250 mm MTL VEL: 5918 m/s DELAY: 0.0 s PULSER: SINGLE REJECT: 0% GAIN: 30 dB RECTIF.: FULL MEASURE:0 TO 1st	Initial pulse and 5 other echoes are displayed. All echoes must be displayed approximately vertically	
Press	The A-scan takes up the whole display.	
INTENSITY: HIGH	Display becomes brighter.	
3. Horizontal linearity		
See 2. for settings.	With a linear sweep the peak shows the: 1st Echo at Div. 2 2nd Echo at Div. 4 3rd Echo at Div. 6 4th Echo at Div. 8 5th Echo at Div. 10	

Check	Result	Remark
4. Range		
For settings see 2. RANGE: switch through from 5 mm to 5000 mm	Initial pulse+Echo for RANGE/with Div.: 50 mm / 0, 10 100 mm / 0, 5, 10 250 mm / 5th Echo at 10 500 mm / 5th Echo at 5 1000 mm / 4th Echo at 2 5000 mm / Echo sequence between 0 and 1	Up to RANGE = 25 mm only initial pulse and post-pulse oscillation visible. Set RANGE to fixed step range and press ◄►.
5. Pulse shift		
See 2. for settings. DELAY approx. -17 µs	1st echo at Div. 4	Maximum shift is dependent on the range and the sound velocity.
DELAY approx. +17 µs	2nd echo at Div. 2	
6. S/N ratio / Spurious oscillationg		
For settings see 2. Also: PULSER: SINGLE GATE LOGIC: POSITIVE a-THRESH: 40% a-START: 40 mm a-WIDTH: 50 mm GAIN so that 1st echo is just over the gate	Both LEDs flash alternately.	
Press dB REF, then remove N30 and increase GAIN until the average value of the noise is 40% SH	read dB REF value: Db REF should be ≥ 80 dB.	Oscillations must not occur.

Check	Result	Remark
7. Suppression (Reject)		
For settings see 2. Set the 2nd echo just under 80% SH		
REJECT: SET 80%	Echos 2 to 5 are consecutively suppressed. Only the initial pulse and the 1st echo at Div. 2 are visible.	2nd echo is visible when the gain is increased by 0.5-1 dB.
Set REJECT to 0% after check		
8. Vertical linearity		
For settings see 2. GATE LOGIC: POSITIVE a-THRESH: 10% a-WIDTH: 50 mm AMPLITUDE: % screen HT GAIN and a-START so that selected echo is in the gate	Height of echo is displayed in the measurement line in % screen HT (H=80%)..	
Increase GAIN by 2dB, then decrease by 2 dB	Amplitude values: + 2 dB = 100% -2 dB = 63% -4 dB = 50% -6 dB = 40% -8 dB = 32% -10 dB = 25% -12 dB = 20% -14 dB = 16% -16 dB = 13% -18 dB = 10%	Deviations must not be more then 2% screen HT. Determine the height at the last measured value, if required, by comparison with the graticule because values below the gate are not displayed

Check	Result	Remark
9. Damping		
For settings see 2. Also: DAMPING: 1 K ohms. Set an echo to 80% screen HT, then DAMPING to 150, 75 and 50 ohms.	The echo drops in each case to approx. 40% (with 150 ohms), 30% (with 75 ohms), 20% (with 50 ohms).	The difference is approx. -6 dB -8 dB -12 dB
10. Resolution test		
For settings see 2. Also: RANGE: 5 mm RECTIF.: NEG HALF Connect CLF4. Shift the 1st Echo of the delay path to the left edge of the display using DELAY, Couple the CLF4 to 1 mm steel. Adjust the 1st echo from the backwall echo sequence to 80% screen HT.	There should be no rise in the sweep between the trailing flank of the delay echo and the rising flank of the 1st backwall echo.	
11. Pulser/Receiver cross-talk		
For settings see 2. PULSER: SINGLE GATE LOGIC: POSITIVE a-THRESH: 10% a-START: 30 mm a-WIDTH: 50 mm N30 in Pulser socket GAIN so that 1st echo is just over 20% screen HTH. Press dB REF, PULSER: DUAL Increase GAIN until the echo or noise is over 20% screen HT.	Read off dB REF value: dB-REF value should be $\geq$ 60 dB.	Echo must exceed gate, otherwise db REF cannot be activated.

Check	Result	Remark
N30 in receiver socket and repeat.		
12. Rectification		
For settings see 2.. GATE LOGIC: POSITIVE a-START: 47 mm a-WIDTH: 7 mm Set 1st echo to 80% screen HT. Press ⎙ . RECTIF.: POS HALF	3 to 4 echo half-waves (echoes) are visible.	
RECTIF.:NEG HALF	3 to 4 echo half-waves (echoes) are visible, horizontally offset as opposed to: RECTIF.: POS HALF.	
RECTIF.: FULL	6 to 7 echo half-waves which overlap each other. Partly the sweep no longer drops to 0% screen HT.	
RECTIF.: RF	The echo having 3 to 4 oscillations is displayed in its original waveshape.	

Check	Result	Remark
13. Gate threshold		
For settings see 2. GATE LOGIC: POSITIVE a-THRESH: 40% a-START: 30 mm a-WIDTH: 40 mm 1st Echo to 38% screen HT.		
Increase GAIN setting by 1 dB.	Both LEDs flash alternately when the echo exceeds the gate.	
a-THRESH: 80% 1st Echo to 78%		
Increase GAIN setting by 1 dB.	Both LEDs flash alternately when the echo exceeds the gate.	
14. Memory		
Set any echo display and store with STORE: ON.	The echo display and settings are stored.	
Remove N30.	Echo display disappears.	
RECALL: ON.	Echo display appears. Echo display and settings must correspond to the condition when stored.	
Switch off instrument Switch on after about 30 seconds. RECALL: ON.	Echo display appears again until a parameter is changed (e.g. GAIN).	

Check	Result	Remark
15. Thickness measurement		
For settings see 2. GATE LOGIC: POSITIVE a-THRESH: 40% a-START: 30 mm a-WIDTH: 100 mm Set 2nd Echo to 40% screen HT.	A sound path between 48 mm and 52 mm must be displayed in the measurement line.	
MEASURE: MULTECHO b-THRESH: 30% b-START: 10%.	2 gates are visible. A sound path between 48 mm and 52 mm must be displayed in the measurement line.	

Documentation 6

6.1 Printing instrument settings and display contents

Using a common EPSON printer or an Epson compatible printer, the USN 52R/USN 52L offers you the opportunity to create a printout of the complete current display including the echo indications.

In addition to this, all settings of the active data set can be printed out for documention purposes.

To do this you will need :

- a printer with serial interface RS 232 C
- a cable for data transfer (TGDL/PC)
- an adaptor/gender changer GCH1 resp. GCH2 (refer to Chapter 2)

Preparing the printer

In the center function group of the right function table set the transfer rate (**BAUD RATE**), the word length (**LENGTH**) and the parity test (**PARITY**) to the suitable values.

BAUD RATE Transfer rate

- 300 Baud
- 600 Baud
- 1200 Baud
- 2400 Baud
- 4800 Baud
- **9600 Baud**

LENGTH Word length

- 7 data bits
- **8 data bits**

PARITY Parity test

- **DISABLED**
- EVEN
- ODD

The default settings are given in **bold-face**.

☞ Note:

In cases of doubt, refer to the technical specifications of the connected device. This is the only way to ensure error-free communication.

In the function **COPY MODE** of the same function group you select which data are to be printed:

- **HARD COPY:** Printout of the display contents
- **REPORT:** Printout of the Data Logger contents
- **THICKNESS:** Transfers the thickness value. When angle function is enabled, the values for S=, P= and D= are transferred.
- **DATA LOGGER**: The Data Logger is enabled for storage of the measured values. When ⋮ is pressed, a measured value is transferred to the Data Logger.
- **DISP+PDUMP**: Prints the A-scan and a single-page test report with all settings relevant to the test.
- **PARAMETER DUMP**: Prints a list of all USN 52 R functions including remode codes and actual settings.
- **MEMO DUMP**: Prints the additonal information added with the active **MEMO** function.

You can also select the printer:

Press ◄ and ► simultaneously in the function **COPY MODE**.

The function **PRINTER SELECT** appears. You can select the following printers:

- **EPSON FX** (also for EPSON LX-300)
- SEIKO DPU 411 (also for Seiko DPU 414)

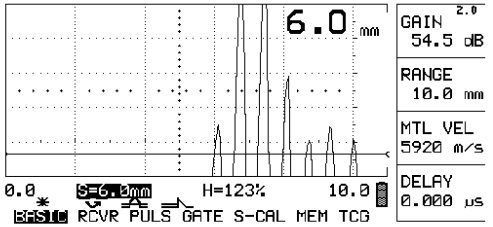
– Select the required printer with ◄►.

– Simultaneously press ◄ and ► again in order to exit the function **PRINTER SELECT**.

You are now in the **COPY MODE** again.

– By activation of ⋮ you can transfer the data to a printer or to the Data Logger.

USN 52 R



GAIN:	54.5 dB	DAC/TCG:	OFF	DAC ECHO:	4
RANGE:	10.0 mm	MTL VEL:	5920 m/s	DELAY:	0.000 us
FREQ.:	.4-10MHz	REP-RATE:	HIGH	DAMPING:	50 OHM
AUTO CAL:	OFF	S-REF1:	25.0 mm	S-REF2:	100.0 mm
PULSER:	DUAL	MEASURE:	0 TO 1st	a-THRESH:	13 %
REJECT:	10 %	TOF:	FLANK	a-START:	0.0 mm
RECTIF.:	NEG HALF	ASCAN:	HOLLOW	a-WIDTH:	15.0 mm
b-THRESH:	25 %	ZERO:	9.303 us	DATA SET:	15
b-START:	15 %	ANGLE:	OFF	X-VALUE:	0.0 mm

THICKNESS:	101.6 mm
AMPLITUDE:	% SCREEN HT
FREEZE MODE:	FREEZE ALL
VELOCITY #1:	5920 m/s
VELOCITY #2:	3250 m/s
GATE LOGIC:	POSITIVE

OPERATOR: _____ USN52 SN: 0074C5

CODE: _____ PROBE SN: _____

LOCATION: _____ CAL BLOCK SN: _____

JOB NAME: _____

TEST COMMENTS: _____

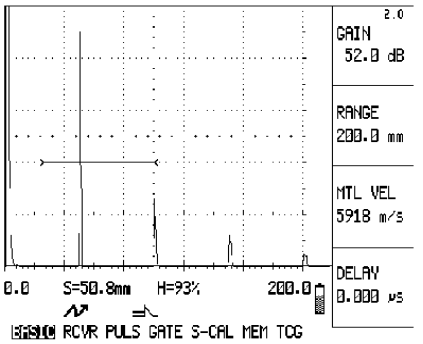
_____

_____

_____

SIGNATURE: _____ DATE: _____

USN 52L



GAIN:	52.0 dB	DAC/TCG:	OFF	DAC ECHO:	0
RANGE:	80.0 mm	MTL VEL:	3250 m/s	DELAY:	0.000 us
FREQ.:	2-8 MHz	REP-RATE:	HIGH	DAMPING:	50 OHM
AUTO CAL:	OFF	S-REF1:	25.4 mm	S-REF2:	101.6 mm
PULSER:	SINGLE	MEASURE:	0 TO 1st	a-THRESH:	40 %
REJECT:	0 %	TOF:	FLANK	a-START:	25.4 mm
RECTIF.:	FULL	ASCAN:	HOLLOW	a-WIDTH:	31.4 mm
b-THRESH:	30 %	ZERO:	6.970 us	DATA SET:	6
b-START:	10 %	ANGLE:	60.0	X-VALUE:	0.0 mm

THICKNESS:	30.0 mm
AMPLITUDE:	% SCREEN HT
FREEZE MODE:	FREEZE ALL
VELOCITY #1:	5918 m/s
VELOCITY #2:	3353 m/s
GATE LOGIC:	POSITIVE

OPERATOR: _____ USN52 SN: 0000C2TF

CODE: _____ PROBE SN: _____

LOCATION: _____ CAL BLOCK SN: _____

JOB NAME: _____

TEST COMMENTS:

SIGNATURE: _____ DATE: _____

6.2 Documentation with the PC program UltraDOC

With the special application program UltraDOC from Krautkrämer you are able to remote control your USN 52R/USN 52L and record instrument settings in your test report in an ASCII format or display contents in PCX or IMG formats.

The program is designed for a number of dialog languages, it is supported by Windows and has a common graphics user interface as well as an internal text editor for numerous dialog languages.

All data can be further processed with normal word processing or DTP programs.

Information with regard to the reliable use of this program is contained in a detailed operating manual.

Servicing and maintenance 7

7.1 Cleaning the USN 52R/ USN 52L

The instrument can be easily cleaned because, due to the membrane keypad, there are no protruding parts on which dirt could collect.

We advise you to only use a damp cloth to clean the instrument and the necessary accessories. Only use water or a mild household cleaning agent.

⚠ **Attention**:

Solvents can cause plastic parts to become brittle and thus damage them.

7.2 Maintenance of NiCd cells

The NiCd cells should be charged in the following cases:

- before operating the instrument for the first time,
- after a prolonged storage time (approx. 3 months),

Charging NiCd cells

You can charge the rechargeable NiCd cells with the Power Supply/Charger unit. Only use the types recommended by us (refer to Chapter 2.2 *Required* Accessories).

– Set the charge switch in the battery compartment of the instrument to NiCd charging.

– Connect the instrument to the Mains/Charger unit.

The batteries are fully charged after 6 to 7 hours.

⚠ **Attention**:

Only use the batteries recommended by us. Inexpert handling of batteries and charger can cause danger of explosion.

Handling NiCd cells

The capacity and life of NiCd cells is dependent on correct handling.

You should therefore observe the following:

- Do not charge NiCd cells until they are discharged to the automatic cutout point in normal operation.
- Excess charging with a current which is too high can cause capacity losses of the NiCd cells.

Handling AlMn batteries

Remove the batteries from the instrument if it has not been in operation for a long time.

⚠ **Attention**:

Leaking batteries can damage the instrument !

Only leakproof batteries may be used, and they are to be removed when the automatic instrument cutoff is activated.

Always remember to set the switch in the battery compartment to **ALK** in order to avoid charging AlMn cells.

☞ **Note:**

Used batteries are special waste and must be disposed of in accordance to statutory regulations!

For the sake of the environment, we recommend that you use rechargeable batteries.

Interfaces, Peripherals 8

8.1 Interfaces

Serial interface RS 232

The 7 pin connector at the back of the instrument is the bidirectional interface RS 232. It enables data transfer to an external device, e.g. printer, PC or the DR1 Data Recorder from Krautkrämer.

The instrument can also receive data transferred from a PC. All keyboard controls and functions are accessible.

The measurement report and other data can be transferred using . The COPY MODE in the lower level sets the data communication initiated by .
The table opposite gives an overlook into RS 232 output possibilities of the instrument.

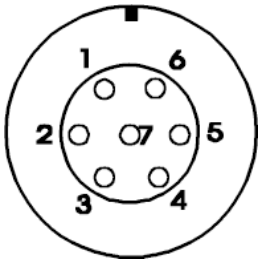
Note:

Use the correct connection cable for each peripheral. Refer to Chapter 2.

Instrument	COPY MODE	Output
No instrument	DATA LOGGER	Internally stores displayed measurement
Serial printer	HARD COPY	USN 52 R display content
	REPORT	Data Logger REPORT with Jobs and statistics
	DISP+PDUMP	Active A-Scan display as well as USN 52 R functions and active settings
	PARAMETER DUMP	Function list, remote codes and actual settings
	MEMO DUMP	Data records with name, number and additional informations
RS232-device (PC, printer)	THICKNESS	The displayed digital measurement value

Layout of 7 pin Lemo socket (RS 232)

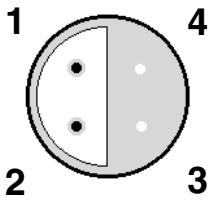
Pin	Description	Direction	Level
1	ground		
2	+ 5 V		
3	TxD (Transmit)	output	TTL
4	CTS (Clear to send)	input	TTL
5	RxD (Receive)	input	TTL
6	ground		
7	external request	output	



Layout of 7 pin Lemo socket RS 232

Layout of 4 pin Lemo socket (charger socket, switching output)

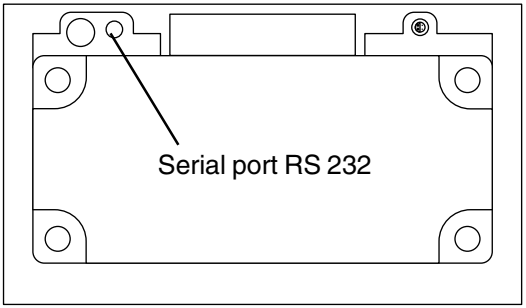
Pin	Description	Direction	Level
1	ground		
2	charge	input	
3	mains connection	input	9 ... 10 VDC
4	alarm	output	Open Collector to ground for alarm



Layout of 4 pin Lemo socket

8.2 Connection of a peripheral

Peripherals are connected to the instrument via the RS 232 interface. The corresponding connection cable is given in Chapter 2.



To have correctly operating data communication between the instrument and the peripheral, the parameters belonging to the interface and the peripheral must be adjusted to each other.

The necessary settings are given in the operating manual of your peripheral device.

When produced, the interface configuration is preset as follows:

- **BAUD RATE**: 9600
- **LENGTH**: 8 DATA BITS
- **PARITY**: DISABLED

If you wish to change the presettings, refer to the necessary operation steps given in chapter 5.

8.3 Transferring the display contents

☞ Note:

The output is formated on an Epson matrix printer with *Intelligent Serial Interface* as well as on a Seiko DPU.

You can print the active display contents by pressing .

Connect the printer connection cable into the RS 232 socket of the instrument. If necessary readjust the transfer parameters as described.

Operation:

– Set **COPY MODE** to **HARDCOPY**.

– If required, extend the A-Scan with .

– If required, expand the gate range over the whole display with .

– When the contents of the display are presented as you would like to have them printed then activate printing with .

The keypad remains disabled until the printing sequence has finished.

8.4 Printing Data Logger report

The Data Logger files are transferred to a serial printer in an ASCII format. The 24 column report format is compatible with all serial 24, 40 80 or 132 column printers if the correct connection cable is used.

The measurement report is printed in the language which you have selected in the **LANGUAGE** function contained in the second operating level.

☞ Note:

In order to print a report of the active job whilst the A-Scan is active, the Data Logger must be enabled and **LOC** as well as **VAL** value displayed in the measurement line.

In order to print reports of other files, you must firstly select the number in the function **FILE NUMBER** in the second operating level.

Operation:

– Set **COPY MODE** to **REPORT**.

– If you wish to print the contents of the active measurement set from the A-Scan, return to the A-Scan display.

– Activate printing with .

Empty measurement locations and files are not printed. The printed files remain stored after printing.

Data Logger report format

The report format of the Data Logger is always the same irrespective of whether the data is transferred to a printer or to a PC. The transfer sequence of data to a PC is described in the following section.

On the next page you will see an example for a Data Logger report with a brief description of the information contained in the individual sections of the report.

```
************************
* KRAUTKRAMER  BRANSON *
*  USM52 - DATA LOGGER *
************************

----- FILE  HEADER -----

COMPANY:

FILE NUMBER:            2

FILE NAME:


SERIAL NUMBER:    0074C5

REVISION:

OPERATOR ID:


PROBE ID:


DATE:


COMMENTS:




--- FILE STATISTICS ---

READINGS        10
MINIMUM          5.7    mm
  AT LOC         1
MAXIMUM          6.5    mm
  AT LOC         6
RANGE            0.8    mm
MEAN             6.1    mm

------- READINGS -------

        1       5.7     mm
        2       5.9     mm
        3       6.0     mm
        4       6.2     mm
        5       5.9     mm
        6       6.5     mm
        7       5.7     mm
        8       6.5     mm
        9       6.2     mm
       10       5.9     mm

       END OF REPORT
```

FILE HEADER: The file number, serial number and software version are automatically entered here. There is space for the operator to enter: company name, file name, operator ID, type of probe used, date and comments.

FILE STATISTICS: The instrument analyzes the thickness data and transmits statistics as shown. If a large number of readings have been recorded, a transmission delay may occur while statistics are calculated. If a reading error has been damaged or corrupted in memory, it is not used in the calculations and “ERROR“ is transmitted in the readings section of the report in place of the original value.

READINGS: The number of valid stored thickness measurements.

MINIMUM and **MAXIMUM**: The smallest and greatest measurements stored in the file.

AT LOC: Related to the location number(s). If the same value occurs in more than one location, all locations are reported.

RANGE: The difference between the MAXIMUM and MINIMUM measurements in the file.

MEAN: The sample mean (average) of all measurements in the file.

READINGS: All measurements are transmitted sequentially, according to location number. Each measurement line has three parts:
1. File location number
2. Thickness value stored in the file location. Empty locations are not transmitted.
3. MM (millimeters) IN (inches). Values are transmitted in the unit of measure to which the instrument is set at the time the report is transmitted.The instrument uses a parity flag to test the validity of each measurement as it is recalled for transmission.

☞ Note:

Any measurement value that has been damaged in memory is thus detected and “ERROR“ is transmitted in its place. Damaged measurement values are not used in calculating statistics.

8.5 Transferring measurement values

Transferring measurements values in the Data Logger to a PC

Measurements in the Data Logger can be transferred to a PC via the RS 232 interface. The data are automatically formated and transferred as an ASCII text file.

The utility program **UltraDOC for Windows**, offered as an option, simplifies data transfer to a PC.

– Connect the RS 232 interface of the instrument with the serial interface of your PC using the cable with Order No. 13 647 from Krautkrämer. A corresponding adapter is supplied for 9 pin serial interfaces.

Data transfer to a PC is made exactly the same as described on the previous page concerning the transfer of a report to a printer.

Printing display contents and instrument settings

Operation:

– Set **COPY MODE** to **DISP + PDUMP**.

– If necessary, optimize the A-Scan.

or

– Set **COPY MODE** to **PARAMETER DUMP**.

– With ⋮ activate printing.

Transfer formats

On the following page you will find an overlook concerning the data formats by transfer of single measurement values. The data format is dependent on the selected unit of measure and the resolution:

- X.XXX IN: Units of measure INCH, 1 before and 2 behind the point
- XX.XX IN: Units of measure INCH, 2 before and 2 behind the point
- XX.XX MM: Units of measure METRIC 2 before and 2 behind the point
- XXX.X MM: Units of measure METRIC 3 before and 1 behind the point

Byte-No.	1	2	3	4	5	6	7	8	9	10	11	12	13
Data Format X.XXX IN	blank	X	.	X	X	X	blank	I	N	blank	blank	CR	LF
Data Format XX.XX IN	blank	X	X	.	X	X	blank	I	N	blank	blank	CR	LF
Data Format XX.XX MM	blank	X	X	.	X	X	blank	M	M	blank	blank	CR	LF
Data Format XX.XX MM	blank	X	X	X	.	X	blank	M	M	blank	blank	CR	LF

blank	space bar
X	Number 0-9
.	Decimal point
IN	Unit INCH
MM	Unit MM
CR	Carriage Return
LF	Line Feed

8.6 USN 52R/USN 52L remote operation

You can remote control the instrument from a PC. Data transfer is carried out with remote control codes. These codes represent instructions which relate to individual USN 52R/USN 52L functions.

The command sequences can be entered via a PC keyboard or via a special user-program such as UltraDOC. With this, there are differences between:

- **Recall** of the value or condition of a USN 52R/ USN 52L function with the command structure:

  <ESC><CODE><RETURN>

  The instrument answers with the value of the active setting

- **Entry** of a new value or condition for the function concerned using the command structure

  <ESC><CODE><BLANK><VALUE><RETURN>

  You can enter the value directly in the required form.

In the following you will find a table with remote control codes, including the settings and resolutions.

The default settings are in **bold-face**.

Function	Code	Setting	Resolution
AMPLITUDE	SA	0: % SCREEN HT 1: dB THRESHOLD	1
Amplitude reading	PK	**Only inquiry**	1
ANGLE	PA	0: **OFF** 10° 90°	1
ASCAN	FI	0: HOLLOW 1: SOLID	1
a-START	AD	0 - 5000 mm **(25,4 mm)**	0,1/ 1 (from 1000 mm)
a-THRESH	AT	10 - 90 % **(40 %)**	1
a-WIDTH	AW	1 - 5000 mm **(76,2 mm)**	0,1/ 1 (from 1000 mm)
b-START	BD	10 - 90 % **(10 %)**	1
b-THRESH	BT	10 - 90 % **(30 %)**	1

Function	Code	Setting	Resolution
BAUD RATE	BR	1: 300 2: 600 3: 1200 4: 2400 5: 4800 6: **9600**	1
COPY MODE	CM	0: **HARD COPY** 1: REPORT 2: THICKNESS 3: DATA LOGGER 4: DISP + PDUMP 5: PARAMETER DUMP 6: MEMO DUMP	1
DAC ECHO	DE	0: **OFF** 1: ON	1
DAC/TCG	DM	0: **OFF** 1: TCG 2: DAC 3: REC	1
DAC Curve	DC	0: **OFF** 1: ON	1
DAMPING	DI	0: **1000 ohms** 1: 150 ohms 2: 75 ohms 3: 50 ohms	1

Function	Code	Setting	Resolution
Configure Data Logger	DL	0: cleared 1: configured	1
SET#	ND	1 - 150 **(1)**	1
Transfer data set to instrument	DD	1 - 150	1
Transfer data set to PC	UD	1 - 150	1
Recall / enter data set name	NA	1 - 150 Name (alphanumeric)	
DB	DB	0 - 110 dB **(30 dB**)	0.1
dB-STEP	DS	6.5 - 24 dB **(24 dB)**	0.1
DELAY	ZE	-20 to +999 µs (range dependent) **(0.000 µs)**	0.008
Depth	DP	**Only inquiry**	
DISPLAY	RF	0: **RF** 1: POS HALF 2: NEG HALF 3: FULL	1

Function	Code	Setting	Resolution
FILE MODE	FS	0: OFF 1: **THICKNESS**	1
FILE NUMBER	FN	0: **ALL CLEAR** 1: SET# 1 - 99 2: Configure 3: EMPTY 1 - 99 4: ACTIVE 1 - 99 5: FULL 1 - 99 6: ALL FILES	 1 1 1 1
FREQ.	FR	0: **0.4 - 10 MHz** 1: 2 - 8 MHz 2: 3 - 10 MHz 3: 0.3 - 4 MHz	1
FREEZE MODE	PC	0: **FREEZE ALL** 1: FREEZE PEAK	1
GAIN	DB	0 - 110 dB **(30 dB)**	0.5
GATE LOGIC	AM	0: **OFF** 1: POSITIVE 2: NEGATIVE	1
GRATICULE	GR	0: **OFF** 1: ON	1
INSTR. RESET	IN	0: **OFF** 1: ON	1

Function	Code	Setting	Resolution
LANGUAGE	DG	1: German 2: **English** 3: French 4: Italian 5: Spanish 6: Portuguese 7: Swedish 8: Danish 9: Norwegian 10: Finnish 11: Dutch 12: Russian	1
LENGTH	LE	7: 7 Data bits 8: **8 Data bits**	1
LOCATION	LT	1 - 2500 (dependent on the number of files)	1
MEAS.UNITS	UN	0: **MM** 1: INCH	1
MEASURE	MM	0: OFF 1: **0 TO 1st** 2: MULTECHO	
MEMO FIELD NO.	HN	0: default 1 - 20: 1 - 20 fields	1
MEMO FIELD SPEC.	HF	## $$ 'string' ## no. of field $$ length of string 'string' field name	1
MEMO TEXT	MT	## 'string' ## no. of field 'string' Memo text	1
MTL VEL	SV	1000 - 9999 m/s **(5918 m/s)**	1
O-DIAM	OD	10 - 2000 mm/**infinite**	1
PARITY	PY	0: **DISABLED** 1: EVEN 2: ODD	1
PRF	RR	0: **HIGH** 1: LOW	1
Projection distance	PR	**Only inquiry**	
PULSER	PG	0: **LOW** 1: HIGH 2: DUAL	1
RANGE	DW	5 - 5000 mm **(254 mm)**	0.1/1 from 1000 mm
RECALL	RD	0: **OFF** 1: ON	
REJECT	RJ	0 - 80 % **(0 %)**	1

Function	Code	Setting	Resolution
STORE	SD	0: **OFF** 1: ON	1
THICKNESS	TH	0.1 - 5000 mm **(101.6 mm)**	0.1
TOF	TF	0: **FLANK** 1: PEAK	1
Thickness inquiry	TK	0: **OFF** 1: ON	1
Velocity #1	V1	1000 - 9999 m/s **(5918 m/s)**	1
Velocity #2	V2	1000 - 9999 m/s **(3353 m/s)**	1
Version	VR	**Only inquiry**	
ZERO	DZ	0 - 1600 µs **(0.000 µs)**	0.1

Function	Code	Setting	Resolution
	CO	0: **OFF** 1: ON	1
	DR	0 - 110	0.1
	ST	0: 0.5 1: 1.0 2: 2,0 3: **6.0** 4: programmable 5: 0.1	1
	FC	0: **OFF** 1: ON	1
	HM	0: **ON** 1: OFF	1
	LO	0: **Unlocked** 1: Locked	1
	MA	0: **OFF** 1: ON	1
	ZO	0: **OFF** 1: ON	1

8.7 Configuring the MEMO function

If the **MEMO** function is switched on, you are able to store additional information on every data set for a better documentation. Depending on the configuration, it is possible to make user-defined entries consisting of 80 alphanumeric characters, or to enter characters in the predefined fields of a data header. You have to define the header by means of remote control commands.

Note:

You can carry out MEMO header configuration and MEMO text entering more easily with the help of the program UltraDOC (from version 3.3).

Defining data header

The data header is defined by means of three remote control commands: HN, HF and MT.

You must always stick to the sequence of commands:

- Start by defining the number of fields with **HN**.
- After that, define the length of **every** field and the corresponding labeling with **HF**.
- Having defined **all** fields (length and labeling), you can enter the texts for the predefined fields directly on the instrument (please see chapter 5), or you can use another remote control command **MT** to input memo text remotely.

Sequence of commands of the MEMO code:

Number of fields:

<ESC>**HN ##**<RETURN>,

in which connection **##** has to be a number between 0 and 10. The number 0 sets the header to the default factory setting. It will then consist of 9 fields having the following names: AMPL | DEPTH | S-PATH | P-DIST | COMMENT1 | COMMENT2.

Note:

If the command **HN** is entered together with a valid number, the existing header is immediately deleted.

Length and name:

<ESC>**HF ## $$ text**<RETURN>,

in which connection **##** has to be the number of the previously defined field. If you have previously entered the command HN 6, you can now only use a number

between 1 and 6 for **##**. **$$** stands for the length of the field, **text** for the field label. The length of the name must not exceed the field length. Shorter names are automatically left-justified. You have to stick to the sequence of the fields when defining field lengths and names, that means start with HF 1 ..., continue with HF 2 ..., etc.

The sum of all field lenghts **must** not exceed 80.

You can define active fields which are automatically filled in with the current data from the A-scan. In that case, these fields can no longer be selected for the entry of texts when storing. To define active fields, use the remote control codes of the corresponding functions preceded by the character \. Type the name of the field directly after the two-digit remote control code.

Example: <ESC>**HF 4 11\PK AMPLITUDE**<RETURN>

The field number 4 will be 11 characters long, it will have the name AMPLITUDE and be automatically filled in with the amplitude value.

The possible codes are:

PK (amplitude, length 9 characters)
TK (sound path, length 9 characters)
PR (projection distance, length 9 characters)
DP (depth, length 8 characters)

The field length is always determined, other values (e.g. 11) are ignored.

Example for a header definition:

<ESC>**HN 9**<RETURN>

<ESC>**HF 1 10 OPERATOR**<RETURN>

<ESC>**HF 2 7 DATA**<RETURN>

<ESC>**HF 3 10 X-COORD**<RETURN>

<ESC>**HF 4 10 Y-COORD**<RETURN>

<ESC>**HF 5 9\PK AMPL.**<RETURN>

<ESC>**HF 6 9\TK S-PATH**<RETURN>

<ESC>**HF 7 9\PR P-DIST**<RETURN>

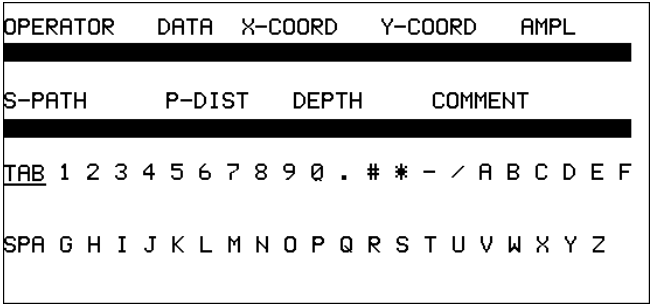
<ESC>**HF 8 8\DP DEPTH**<RETURN>

<ESC>**HF 9 8 COMMENT**<RETURN>

After the last field has been defined, the reply is:

OK.

The fields 5 to 8 are automatically filled in.



Entering MEMO text:

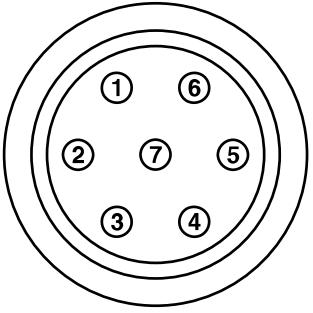
<ESC>**MT ## text**<RETURN>,

in which connection **##** must be the number of a defined field. **text** stands for the required text. The length of the text must not exceed the field length. Shorter texts are automatically left-justified, longer texts are automatically shortened.

8.8 Analog outputs

The instrument has on its rear panel a 7-pin LEMO socket which provides analog switching and control voltages when the instrument is correspondingly set. The UNAN cable, which has a LEMO plug on the instrument side, is used as an accessory for utilizing the analog voltages.

There is no plug on the user side. Use the connections according to your requirements as shown in the table opposite:



Function	LEMO connection USN 52 R	Cable color analog cable UNAN
Amplitude	**1**	brown
Ground	**2**	yellow
Sound path	**3**	red
Ground	**4**	orange
Alarm	**5**	green
Ground	**6**	blue
Data valid	**7**	black
Not used		gray

Analog voltage for the echo amplitude (echo in the monitor gate)

a) Rectified echoes

0 volt: no echo in the gate;
echo amplitude = 0% screen HT

2.5 volts: echo amplitude = 128% screen HT

b) RF mode

-1.25 volts: echo amplitude = -64% screen HT

+1.25 volts: echo amplitude = +64% screen HT

Analog voltage for the sound path of an echo

a) MEASURE = 0 TO 1st

0 volt: sound path = a-START;
echo is exactly at gate start

1.25 volts: sound path = a-START +0.5 a-WIDTH;
echo is exactly at gate center

2.5 volts: sound path = a-START + a-WIDTH;
echo is exactly at gate end

2.5 volts: no echo in the gate

b) MEASURE = MULTECHO

The output voltage corresponds to the ratio of the measured wall thickness to the gate width. If there is no echo in the gate, the output voltage is 2.5 volts.

TTL switching output

The switching output serves for external control purposes if there is a gate alarm. According to the following table, the following voltages are available at the connections 5 (green) and 6 (ground, blue):

	GATE LOGIC: POSITIVE	GATE LOGIC: NEGATIVE
Echo < gate threshold	0 volt	5 volts
Echo > gate threshold	5 volts	0 volt

The maximum load capability of the switching output is 2.5 mA.

Specifications 9

Range	From 5 to 5000 mm for steel$_{long}$, continuously variable or variable in fixed steps		
Material velocity	Continuously adjustable from 1000 to 9999 m/s, 2 programmable fixed values		
Pulse shift	From -20 to +784 µs, depending on range setting		
Delay for digital time-of-flight measurement	Approx. up to 999 ms (range dependent)		
Gain	From 0 to 110 dB variable in steps of 0.5 dB; fixed steps selectable between 0.1 / 0.5 / 1.0 / 2.0 / 6.0; variable step from 6.5 to 24 dB programmable in 0.1 dB steps		
Pulse repetition rate	Setting	REP-RATE	Range (with 5920 m/s)
	HIGH	905 Hz	5 mm to 295 mm
		452 Hz	296 mm to 589 mm
		226 Hz	590 mm to 1178 mm
		113 Hz	1179 mm to 5867 mm
	LOW	452 Hz	5 mm to 295 mm
		226 Hz	296 mm to 589 mm
		113 Hz	590 mm to 1178 mm
		56 Hz	1179 mm to 5867 mm
Test modes	Pulse-echo and Transmit/Receive (Dual)		
Pulser	Spike/excitation pulse		
Damping	50 ohms, 75 ohms, 150 ohms and 1000 ohms		

Display rectification	Half-wave positive/negative, full-wave and RF
Frequency (-3dB ranges)	0.4 MHz to 10 MHz 2 MHz to 8 MHz 0.3 MHz to 4 MHz 3 MHz to 10 MHz
Unit of measure	mm or inch
Display	USN 52R: EL display, 146 mm x 67 mm, 552 x 256 pixels USN 52L: transflective LCD display, 114 mm x 75 mm, 480 x 320 pixels, switchable backlight, selectable contrast Both versions: A-scan in a filled (SOLID) or curve (HOLLOW) mode, enlarged thickness reading selectable, status symbols for battery charge, pulser, measurement mode, lock and menu selection
Refresh rate	60 Hz (REP-RATE = HIGH) 30 Hz (REP-RATE = LOW)
Measurement resolution	Minimum: 0.1 mm or 0.5% display width
Echo height resolution	1% screen height
Noise suppression	Adjustable from 0 to 80% screen height, absolutely linear,
Language	Either German, English, French, Spanish, Italian, Portuguese, Danish, Swedish, Norwegian, Finnish, Dutch and Russian

Gate	Variable over the whole sweep range in steps of 0.1 mm, alarm indication with flashing LEDs, threshold adjustment from 10 to 90% screen height, separate second monitor threshold for the multiecho measurement mode with controlled blocking and first echo start functions
Measurement modes	Zero to first echo, multiple echo in gate with adjustable second threshold, time of flight to peak or flank in gate, amplitude evaluation as a % of screen height or as a dB difference to the reference echo up to 127%. dB reference value with reference gain data as well as gain changes as + or - values (indicated on display)
Trigonometr.functions	Automatic calculation and display of flaw position in angle beaming: • sound path • projection distance • reduced projection distance • depth • number of reflections (graphically) on flat and uniformly curved test objects up to a minimum diameter of 52 mm
Data memory	Up to 140 instrument setups, storage of all instrument parameters and A-scan, presentation and printout of stored A-scans
Data Logger	Sequential storage of 2500 thickness readings with clear, review and direct report features, configurable up to 99 files, measured values for the corresponding files are determined by the file configuration
DAC/TCG	Recording of up to 9 reference echoes, dynamic range 40 dB, maximum slope 6 dB/µs, representation as Curve (DAC) and Time-Corrected Gain (TCG)

DGS evaluation (option)	13 fixed-programmed probes, one probe user-definable; sound attenuation correction for reference block and test object, transfer correction and quadrant echo correction (for angle probes), reference reflectors: backwall, side drilled hole or circular disk
Storage temperature	From -40 °C to +75 °C
Operating temperature	From 0 °C to + 55 °C
Interface	RS 232 C, bidirectional for data transfer to a serial printer (EPSON format) or to a PC, or remote control of all settings from the PC
Analog output	5V TTL switching voltage with gate alarm 0V to 2.5V analog voltage proportional to the echo amplitude 0V to 2.5V analog voltage proportional to the sound path of an echo in the gate
Battery mode	6 AlMn or NiCad batteries (D-size)
	Operation period with fully charged NiCd batteries (5 Ah): USN 52R: 5.5 hours USN 52L: 10 hours
Probe connectors	BNC or LEMO
Weight	2.7 kg including batteries
Dimensions	250 mm x 133 mm x 146 mm (W x D x H)

Appendix 10

10.1 Function directory

In the first column of the following table, all function names are listed (function group or table in brackets). The second column contains a brief description of the corresponding function.

The adjustment range and the function parameters can be found in the tables of Chapter 8.6 together with information concerning resolution and adjustment accuracy.

Function	Description
a-START (GATE)	Selection of the start point of the corresponding gate
a-THRESH (GATE)	Adjustment of the level of the gate threshold in % of screen height
a-WIDTH (GATE)	Adjustment of the gate width related to the start point of the corresponding gate
AMPLITUDE (left)	Selection of the measurement mode for the evaluation of the flaw amplitude
ANGLE (center)	Entry of the probe's angle for calculation of the flaw location
ASCAN (center)	Setting the echo display (as outline or filled)
AUTO CAL (right)	Enables automatic calibration
BAUD RATE (right)	Adjustment of the baud rate for data transfer via the RS232 interface
COPY MODE (center)	Selection of type and form of printout
CURVE (TCG)	Display of DAC curve
DAC ECHO (TCG)	Number of reference echoes of the DAC curve; storage of one reference echo in the recording mode (REC)
DAC/TCG (TCG)	Setting of DAC/TCG function
DAMPING (RCVR)	Setting of damping resistor

Function	Description
DATA SET (MEM)	Selection of a data set which is to be stored or loaded
DATA SET DIREC (left)	Recalls directory of all data sets
DATA SET NAME (left)	Entry of data sets name
DATA SET PREVIEW (MEM)	Preview of A-Scans (data sets)
dB STEP (left)	Setting the step width for the gain change
DELAY (BASIC)	Adjusts timing of sweep start for the screen display
FILE MODE (left)	Enabling or disabling the Data Logger
FILE NUMBER (left)	Selection of one or all sets
FREEZE MODE (left)	Selection of the mode for storing the display contents
FREQ. (RCVR)	Selection of operating frequency setting
GAIN	Gain setting
GATE LOGIC (left / right)	Selection of the condition under which the gate alarm is activated
GRATICULE (left)	Enabling or disabling of graticule in the A-Scan
INTENSITY (left)	Only USN 52R: Sets display brightness

Function	Description
LANGUAGE (center)	Selection of the instrument dialog language
LENGTH (center)	Determination of the byte length for data transfer via the RS232 interface
LOCATION (left)	Selection of location in the active set
MEASURE (right)	Selection of the correct measurement mode according to the type of probe used
MEAS. UNITS (center)	Sets unit of measure for display and evaluation
MEMO (right)	Switching on of the MEMO function and entry of additional information
MTL VEL (BASIC)	Adjustment of the sound velocity in the meterial
O-DIAM (center)	Adjustment of the outside diameter with curved surfaces
PARITY (center)	Parity check for data transfer via the RS232 interface
PRINTER SELECT (center)	Selects printer driver
PULSER (PULS)	Change of operating mode
RANGE (BASIC)	Sets range to be displayed
RECALL (MEM)	Loading of a data set selected with DATA SET
RECTIF. (RCVR)	Selection of signal display mode

Function	Description
REJECT (PULS)	Suppression of unwanted signals
REP-RATE (PULS)	Change of pulse repetition rate
STORE (MEM)	Storage of a data set selected with DATA SET
THICKNESS (center)	Thickness of the test material for calculation of the flaw location
TOF (right)	Selection of measurement point distance measurement
VALUE (left)	Displays selected file/location and clears it
VELOCITY #1, **VELOCITY #2** (left)	Setting of both fixed values for the material velocity
X-VALUE (center)	Distance of the probe's front edge to the beam indes point for calculation of the flaw location
ZERO (S-CAL)	Adjustment of probe delay for distance measurement

10.2 EC Certificate of Conformity

USN 52R/USN 52L conform to the following EU directives:

- 89/336/EEC (Electromagnetic compatibility)
- 73/23/EEC, amended by the directive 93/68/EEC (Low-voltage directive)

The conformity with the requirements of the EU directive 89/336/EEC is proven by the observance of the standard specifications

- EN 55011, 12/1998, Class A, Group 2, and
- EN 50082-2, 02/1996.

The conformity with the requirements of the EU directive 73/23/EEC, amended by 93/68/EEC, is proven by the observance of the standard specifications

- EN 61010, Part 1, 03/1994, and
- EN 61010-1/A2, 05/1996.

10.3 Service addresses

USN 52R/USN 52L are made with high-quality components according to the latest production methods. Strict intermediate inspections and a quality assurance system, certified according to DIN ISO 9001, guarantee optimum quality of conformance of the instrument.

However, should you establish an instrument defect, contact your nearest authorized Krautkrämer or Krautkramer-Branson Service giving a description of the defect.

Retain the packing case, should it be necessary to return the instrument for repair.

If you have any questions with regard to application, operation and to the specifications of your ultrasonic instrument, contact your local Krautkrämer representative or directly:

Krautkrämer GmbH & Co. oHG

Service-Center
Robert-Bosch-Straße 3
D - 50354 Hürth

P.O Box 1363
D - 50330 Hürth

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Changes 11

Changes

This chapter contains descriptions of any recent changes if applicable.

Otherwise this chapter will remain empty.

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Option DGS

Operating Manual

This issue 02, 05/99 applies to the following software version:

R5 TCG/DGS
R6 TCG/DGS

L4 TCG/DGS
L5 TCG/DGS

Introduction 1

1.1 How to measure with the DGS

The DGS option (Distance - Gain - Size) enables you to compare the reflecting power of a natural flaw in the test object with the reflecting power of a theoretical flaw (disk-shaped reflector) at the same depth.

Attention:

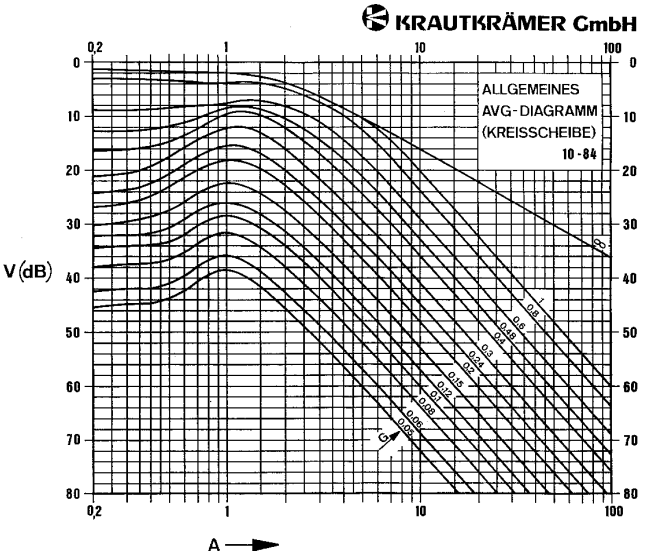
You are comparing the reflecting power of a natural flaw with that of a theoretical flaw (= disk-shaped reflector) at the same depth. No definite conclusions with regard to the natural flaw (roughness, oblique position, etc.) are permitted.

The basis of this comparison of the reflecting powers is the so-called DGS diagram. This diagram consists of a set of curves showing the interrelationship of three influencing factors:

- Distance **D** between probe and disk-shaped reflector,
- Gain difference **G** between disk-shaped reflectors of different sizes and an infinitely large backwall,
- Size **S** of the disk-shaped reflector.

The factor **S** is always constant for one curve of the set of curves.

The following illustrates the general DGS diagram. This diagram is standardized with regard to the near-field length and the element diameter:



The advantage of this method lies in the fact that you can carry out reproducible evaluations of small discontinuities. The reproducibility is especially important if you want to carry out e.g. an acceptance test.

Besides the influencing factors already mentioned, there are other factors that determine the curve shape:

- sound attenuation,
- transfer losses,
- amplitude correction value,
- probe.

The probe influences the curve shape by the following parameters:

- element diameter,
- frequency,
- delay line length,
- material velocity in the delay line.

You can adjust all these parameters on the USN 52R/ USN 52L option DGS so that you are able to use the DGS method with many different probes and on different materials.

There are 13 frequently used probes with their corresponding data already stored in the instrument; you can enter data for 1 more probe. You should allocate one data set to each probe.

1.2 Overview of the method of proceeding

Record a reference echo and adjust the required recording level. The reference echo reflector may be disk shaped, a side drilled hole, or a backwall. The equivalent reflector size is then infinite. If a flaw echo occurs, the amplitude may exceed the DGS curve. In that case, the reflecting power of this natural flaw is greater than the reflecting power of the disk-shaped reflector at the same depth.

With a saturation over 100% and below 10%, the DGS curve is always horizontal.

Overview of the DGS menu 2

2.1 DGS mode

Switch from TCG to DGS mode

The DGS function is activated in the second operation level.

– Press ⊞ to switch to the second operation level.

– With ◀ ▶ go to the “right“ function table.

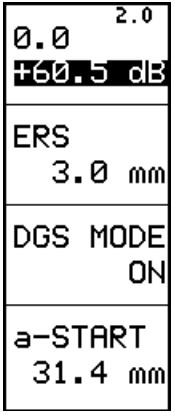
AUTO CAL OFF		EVALUAT. MODE TCG
GATE LOGIC POSITIVE		
MEASURE 0 TO 1st		
TOF PEAK		

– With ◁ ▷ select the right function group and set the function **EVALUAT. MODE** to **DGS** using the ◂ ▸ keys.

– Press ↖ to return to the first operating level.

In the menu line now the menu **DGS** is displayed instead of **DAC**.

The corresponding function group is displayed.



Function group DGS mode

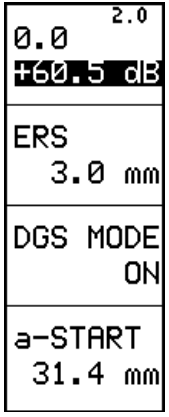
In the first operation level you can carry out a DGS measurement. This includes

– adjustment of the reference gain and incremental gain,

– adjustment of the recording limit,

– switching-on of the DGS mode and the DGS curve display,

– shifting of the gate to select the echo to be evaluated.



Menu functions

Function	Description	Ranges/Options	Keys
GAIN	With the DGS mode switched on, the GAIN function indicates reference gain and incremental gain.	0.0 to 110.0 dB in steps of 0.5, 1.0, 2.0, 6.0 or user defined	dB REF switchover between reference gain and incremental gain ◄ - decrement ► - increment
ERS	The ERS function (Equivalent Reflector Size) defines the recording level.	INFINITE 0.5 to 35 mm limited by probe parameters	◄ - decrement ► - increment
DGS MODE	The DGS function switches the DGS mode on or off.	ON, OFF	◄ or ►
A-START	The A-START function defines the horizontal position of the gate.	0.000 to 5000 mm continuously variable	◄ - Gate to the left ► - Gate to the right

Function table DGS mode

In the second operation level you can make the default settings for a DGS measurement.

– Switch to the second operation level: ⊞

– Tag the function table DGS: ◀ or ▶

PROBE-# 2	X-DIAM 10.0 mm	ATT-REF 0.0 dB/m
P-NAME MB4-S	X-FREQU 4.00 MHz	ATT-OBJECT 0.0 dB/m
	REF-ECHO BW	AMPL-COR 0.0 dB
DEL-VEL 5918 m/s	REF-SIZE INFINITY	T-CORRECTION 0.0 dB

Menu functions

Function	Description	Ranges/Options	Keys
PROBE-#	Probe ID number with the corresponding probe adjustment data. Nos. 1- 13 are preallocated and cannot be changed	1 - 16	◄ or ► - indicates the previous or the next number.
P-NAME	Probe name, corresponding to the selected PROBE-#. Probe nos. 1-13 are preallocated, at no. 16 you can specify your own probe.	MB2-S, MB4-S, B2-S, B4-S, WB45-2, WB60-2, WB70-2, MWB45-2, MWB60-2, MWB70-2, MWB45-4, MWB60-4, MWB70-4, [PROBE 14], [PROBE 15], [USER DEFINED]	◄► - Move cursor by one position to the right ◄ or ► - scroll through an alphanumeric set of letters
DEL-VEL	Material velocity in the probe delay line.	1000 - 9999 m/s preallocated for probe nos. 1-13	◄ - decrement ► - increment
X-DIAM	Diameter of probe element. If the probe element is rectangular, enter the diameter of a round probe that has the same near-field length.	3 - 35 mm Probe nos. 1-13 are preallocated	◄ - decrement ► - increment

Function	Description	Ranges/Options	Keys
X-FREQU	Frequency of the probe element	0.5 - 10 MHz for probe nos. 1 - 13 are preallocated	◄ - decrement ► - increment
REF-ECHO	Type of the reference reflector used	DSR - (disk-shaped reflector) SDH - (side-drilled hole) BW - (backwall)	◄ or ► - indicates the required option
REF-SIZE	Diameter of the reference reflector is automatically INFINITE if REF-ECHO is set to BW (backwall).	INFINITE 0.5 - 35 mm (limited by the probe parameters)	◄ - decrement ► - increment
ATT-REF	Sound attenuation in the reference block	0 - 100 dB/m	◄ - decrement ► - increment
ATT-TEST	Sound attenuation in the test object	0 - 100 dB/m	◄ - decrement ► - increment
AMPL-COR	Value for the amplitude correction. This is required if you are using an angle-beam probe (value as per probe data sheet)	-20 - +20 dB	◄ - decrement ► - increment
T-LOSS	Transfer loss. Compensates for differences in coupling conditions between reference and test block.	-20 - +20 dB	◄ - decrement ► - increment

Operating the DGS 3

For general information on operation, please refer to the USN 52 R Operating Manual.

Attention:

You cannot estimate any flaw sizes with the DGS option of the USN 52R/USN 52L. You can only compare the reflecting power of a natural flaw with that of a theoretical flaw (= disk-shaped reflector) at the same depth.

3.1 Storing a new probe

There are 13 probes including the corresponding parameters stored in the instrument. You can program another probe.

– Switch to the second operation level: ⊞

– Tag the function table DGS: ◀ or ▶:

PROBE-# 2	X-DIAM 10.0 mm	ATT-REF 0.0 dB/m
P-NAME MB4-S	X-FREQU 4.00 MHz	ATT-OBJECT 0.0 dB/m
	REF-ECHO BW	AMPL-COR 0.0 dB
DEL-VEL 5918 m/s	REF-SIZE INFINITY	T-CORRECTION 0.0 dB

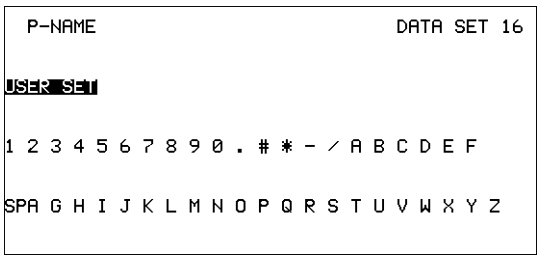
– Tag the left column of this function table: ◁ or ▷

– Select no. 16 in the **PROBE-#** function.

– Enter a probe name as follows:

– Simultaneously press ◄ and ► allocated to the function **P-NAME**.

You will see the following display:



The cursor flashes at the entry position.

In the two lower lines you will see letters, numbers and characters which you can use for the data set name.

To enter the required text, start by selecting the entry position in each case, and then select the character which should be inserted at this position.

The entry position and character are always marked by a flashing cursor. You can enter all required characters in any chosen order.

– Press the keys ◄ or ► in order to change the entry position.

– Press the keys ◄ or ► next to the corresponding character string in order to select a character. The flashing cursor changes the string automatically. The highlighted character is immediately inserted at the entry position.

– Finally, press the key ⊕ to store the entries.

Note:

The probe name is stored together with the data set. You can use the same probe name for more than one data set if the probe parameters differ. However, we strongly recommend you to use different probe names for different probes.

☞ Note:

Before entering the probe parameters, please read the probe data sheet.

– Enter the material velocity in the probe delay line (function **DEL-VEL**).

– Tag the mid column of the DGS function group: ◁ or ▷

– Enter the element diameter.

☞ Note:

If the probe element is rectangular, enter the diameter of a round probe that has the same near-field length.

– Enter the probe frequency.

3.2 Preparing the DGS evaluation

Before carrying out any DGS evaluation, you must make some basic adjustments. These include:

- adjustment of the A-scan representation and digital measured-value display,
- entry of probe parameters,
- entry of all material-related influencing factors,
- entry of recording level according to the corresponding standard specifications,
- recording of the reference echo.

For the reference echo you need a test block with a known reflector. This reflector can be one of the following types:

- backwall
- disk-shaped reflector
- side-drilled hole. With known diameter of the side-drilled hole, the diameter of a corresponding disk-shaped reflector can be calculated, provided that the following requirements are met:
  $D_{SDH} \geq 1{,}5\ \lambda$
  $s \geq 1{,}5\ N$

  with D_{SDH}: diameter of side-drilled hole
  s: sound path in the test object
  λ: wavelength in the test material
  N: near-field length of the probe used in the test material
  D_{ESR}: diameter of the equivalent disk-shaped reflector

$$D_{ESR} = \sqrt{\frac{\sqrt{2}}{\pi}\lambda\sqrt{sD_{SDH}}}$$

Operation

Note:

Before measuring, use ◂▸ to select the setting **PEAK** in **MEASURE**. In addition, activate the gate.

– Connect the required probe to the USN 52 R and select a suitable reference block for receiving the reference echo.

– Adjust the A-scan and digital display (please refer to USN 52R/USN 52L Operating Manual, Chapter 5).

Attention:

Proper A-scan and digital calibration will assure that the MTL VEL and ZERO parameters are set correctly, which is necessary for an accurage DGS curve.

– Switch to the second operation level: ⊞

– Tag the function table DGS: ◀ or ▶

– Tag the left column of the DGS function group using ◁ or ▷.

– Select the required probe number.

Note:

There are 13 probes with the corresponding parameters stored in the unit. You can enter a probe of your own at probe number 16, please refer to **Storing a new probe**, Chapter 3.

Note:

All of the following parameters must be programmed in order to generate a DGS curve.

– Enter the shape of the reference reflector in the **REF-ECHO** function.

– Enter the size of the reference reflector.

If you have selected Backwall as the shape of the reference reflector, the size of the reference reflector is automatically infinite.

Note:

The adjustable size of the reference reflector depends on the probe. The minimum size permitted is 5 % of the element diameter.

– Enter the sound attenuation in the reference block in the **ATT-REF** function.

– Enter the sound attenuation in the test object in the **ATT-TEST** function.

– Enter a value for the amplitude correction for angle-beam probes in the **AMPL-COR** function (correction value as per data sheet).

The following reference blocks are available for angle-beam probes:

- Reference echo for 2 MHz probes is the echo from the 100mm circular arc of the calibration block 1.
- Reference echo for 4 MHz (MWB...) probes is the echo from the 25 mm circular arc of the calibration block 2.

– Enter a value for the transfer loss in the **T-CORRECTION** function.

Attention:

When entering the transfer loss value it is important to note the following:

This value indicates changes in sensitivity (in dB) for the evaluation of discontinuities when the reference block and the test object have different coupling conditions (surface roughness and/or curvature).

Example:

If the surface of the test object is greatly corroded and the reference echo originates from a smooth surface reference block, then the sensitivity is reduced (e.g. by 8 dB). Correspondingly, the value for the transfer correction must be entered **negative**, e.g. T-CORRECTION = -8 dB.

This method is different from the usual way. Normally, transfer loss is the value by which the gain must be increased in order to compensate for the sensitivity loss caused by a rougher surface.

You have now made all basic adjustments and are able to carry out a DGS evaluation.

3.3 Carrying out a DGS evaluation

When carrying out a DGS evaluation, you compare the reflecting power of a natural reflector with that of a disk-shaped reflector. You are not making any flaw size estimation.

– Make the basic adjustments for a DGS evaluation.

– Specify the reflector type and size.

– Switch to A-scan display: ↖

– Couple the probe and the reference block, and peak the reference echo.

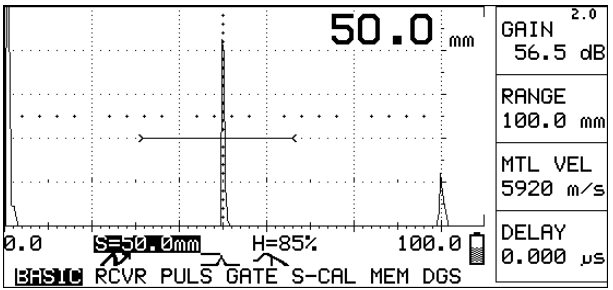
– Tag the function group **DGS**: ◁ ▷

– Adjust the required amplitude height of the reference echo in the **GAIN** function: ◂ or ▸

– Set the gate to the reference echo.

Note:

The reference echo must have the highest amplitude within the gate, as shown in the figure below:



– Record the reference echo: dB REF

The status line shows the reference echo symbol: ⌒

Note:

If the reference echo symbol does not appear, no reference echo was recorded. Possible reasons are:

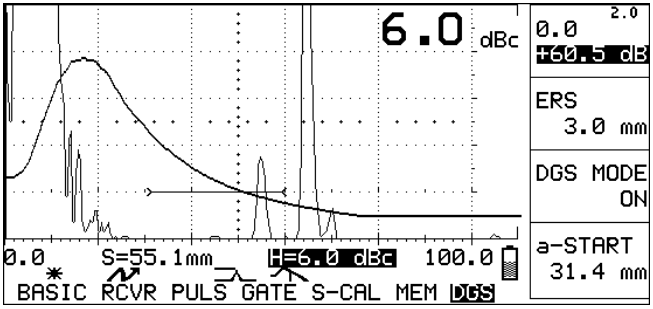
- The reference echo is outside of the monitor gate.
- The amplitude of the refernce echo is either too low or too high.
- The reference cho comes from a side drilled hole, and the conditions to use it are not met (ref. to chapter 3.2).

Correct the settings correspondingly and record the reference echo again.

– Enter the required recording level in the **ERS** function: ◄ or ►

– Switch the DGS mode on in the **DGS** function: ◄ or ►

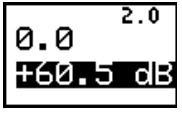
The display shows a DGS curve:



The **GAIN** function shows the incremental and reference gain, e.g:

incremental gain

reference gain



– Press dB REF to alternate between reference gain and incremental gain. The gain currently selected is highlighted in the display.

– Vary the corresponding value with ◄ or ►.

If you vary the reference gain, the curve moves vertically up or down, depending on the direction in which you are varying the gain. This is used for dynamic extension beyond the visible section of the curve.

If you vary the incremental gain, the echo amplitudes change without the curve being affected in any way. This is used for adjusting the detection sensitivity or for measuring linear extensions (half-value length).

Note:

The selection of an echo for the digital measured-value display is made with the gate, and not with the curve.

The parameter H in the measurement line shows the amplitude difference between the highest echo and the curve at the same depth. The data can be given either in dBc or in %, depending on the adjustment you have made in the amplitude parameters (you make these adjustments by setting the **AMPLITUDE** function to **dB-THRESHOLD** in the 2nd operation level). You should use the dBc setting.

☞ Note:

If the **DGS** function is switched on while you vary a parameter that affects the stored reference echo, or when you use another probe, the following message is displayed:

“Clear REF and confirm with HOME”

This text remains blinking on the display for a few seconds. If you press the ↖ key during this time, the reference echo is cleared and the DGS function is switched off.

3.4 Switching off the DGS mode

If you switch off the DGS mode, the USN 52 R option DGS automatically sets the gain to the total of reference gain and incremental gain.

– Switch the DGS mode off in the **DGS** function: ◄ or ►

After switching off the DGS mode, the reference echo remains stored. You can clear it by pressing ◄► belonging to the **GAIN** function.

3.5 Storing data

With the function **STORE** (function group MEM) you store your acitve instrument setting and the active A-Scan including the reference echo.

Attention:

When recalling stored data sets make certain that for further operation with the instrument the same probe has to be used as for recording the reference echo.

Codes for remote control 4

Codes for remote control

The USN 52R/USN 52L option DGS can receive coded commands from a PC. To enable this you must connect the instrument with the PC via the RS232 interface. (Please refer to USN 52R/USN 52L Operating Manual, chap. 8. In addition, you will find in the Operating Manual the codes for the remote control of all instrument functions except for the DGS function.)

The tables show the codes for the remote control of the DGS mode, the ranges or parameters, and the resolution.

The functions are arranged in alphabetical order according to the names appearing in the menu.

The column “Code” shows the letter combinations that you should enter on the PC in order to start the corresponding function on the USN 52R/USN 52L option DGS.

The column “Range/Parameter” shows either the adjustment ranges of the corresponding functions or a list of the corresponding options.

The column “Resolution” indicates the smallest steps that you can use to increment/decrement the corresponding values.

Function	Code	Range/ Parameter	Resolution
EVALUAT. MODE	EV	0: TCG 1: DGS	1
PROBE-#	PB	1 - 16	1
P-NAME	PN	8 letters	
DEL-VEL	DV	1000 - 9999 m/s	1
X-DIAM	XD	3 - 35 mm	0.1
X-FREQU	XF	0.5 - 10 MHz	0.25
REF-ECHO	RE	0: DSR 1: SDH 2: BW	1
REF-SIZE	RS	0: INFINITE 0.5 - 35 mm	0.1

Function	Code	Range/Parameter	Resolution
ATT-REF	AR	0 - 100 dB/m	1
ATT-TEST	AS	0 - 100 dB/m	1
AMPL-COR	AV	–20 - +20 dB	0.5
T-LOSS	LS	–20 - +20 dB	0.5
DGS	DO	0: OFF 1: ON	1
ERS	ES	0: INFINITE 0.5 - 35 mm	0.1